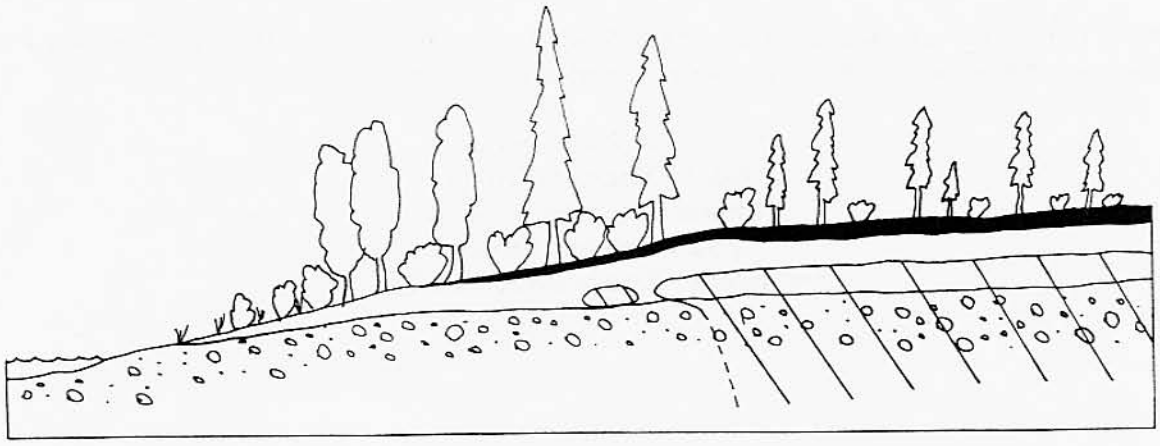
Landscape Ecosystems of the Kobuk Preserve Unit Gates of the Arctic National Park Alaska

David K. Swanson

Technical Report NPS/ARRNR/NRTR-95/22



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January, 1995

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Natural Resources Conservation Service
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Foreword

This is an integrated study of landforms, soils, and vegetation in the Kobuk Preserve Unit, Gates of the Arctic National Park. The study was carried out by the Natural Resources Conservation Service at the request of Gates the Arctic National Park. Its main purpose is to help park managers predict the potential impacts of road development in the Preserve and direct that development (if it takes place) away from sensitive areas. The study is also intended to provide basic ecologic information for research, wildlife management, and education of park staff and visitors.

This report is accompanied by 12 transparent map overlays covering the following 1:63,360-scale US Geological Survey quadrangles: Survey Pass A-2, A-3, A-4; Hughes C-3, C-4, C-5, C-6, D-2, D-3, D-4, D-5, and D-6. Contact Gates of the Arctic National Park in Fairbanks, Alaska or the Fairbanks Field Office of the Natural Resources Conservation Service for these maps.

Acknowledgements

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Thanks to Donna Devoe for valuable help in field data collection, travel and camp logistics, and data entry. Thanks also to Shelli Swanson for field help in 1992. Thanks for comments on a draft of this report by Larry Edland, Darrell Kautz, J. David Swanson, and Dan LaPlant of the NRCS, and Shelli Swanson of the National Park Service.

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Chapter 1: Study Area Summary

The Kobuk Preserve Unit covers about 250,000 ha in north-central Alaska south of the Brooks Range (Fig. 1). The major physiographic features are lowlands along the Kobuk River and surrounding highlands. Elevations range from 140 m (450 feet) to 1450 m (4765 feet) above sea level. The lowlands and lower mountains slopes are generally forested; tundra is present in the lowlands in the western part of the study area and at higher elevations throughout.

Land use history

The upper Kobuk region was originally inhabited by nomadic Inupiat (Eskimo) people. This region lies near the boundary between traditional Inupiat and Athabaskan lands, so the latter people may also have used the area. Both groups subsisted by hunting, fishing, and plant gathering (Brown, 1988).

The arrival of people of European descent and the gold rush caused major changes in the social life of the region, but the land itself has been little affected. Little gold mining took place, and only the ruins of a few cabins remain (Brown, 1988).

At the present the area is used for hunting, trapping, fishing, and recreational trips. The former three activities are regulated by ANILCA sections 1313 and 1314 and state law. Recreational trips are usually by boat, from Walker Lake down the Kobuk River to the western boundary of the Preserve.

ANILCA section 201(4) provides for a right-of-way across the Kobuk Preserve Unit to connect the Ambler Mining District (in the mountains west and north of the preserve) with the Dalton Highway to the east. There are currently no roads or permanently occupied dwellings in the Preserve.

Climate

The study area has a subarctic continental climate; summers are short and warm with frequent light rain, and winters are long and cold. Temperature and precipitation data is available for Kobuk, about 40 km west of the study area and 43 m (140 feet) above sea level (Table 1). Precipitation at higher elevations in the study area probably is higher than at Kobuk. Snow data is available for Bettles, about 100 km east of the study area at 196 m (644 feet). Late winter (1 April) snow depths at Bettles average 81 cm (32 inches), with 18 cm (7.0 inches) of water stored in the snowpack (Table 2).

Estimates of potential evapotranspiration (after Thornthwaite, 1948) for Kobuk show a surplus of precipitation over potential evapotranspiration for the period September through April, a deficit for May through July, and a near balance for August. Potential evapotranspiration and precipitation are estimated to be roughly equal for the year as a whole. These estimates agree in general with field observations of the soil moisture balance, although in my two years of fieldwork both July and August probably had moisture surpluses. Patric and Black (1968) have argued that Thornwaite's method is accurate in Alaska, though some doubt still exists.

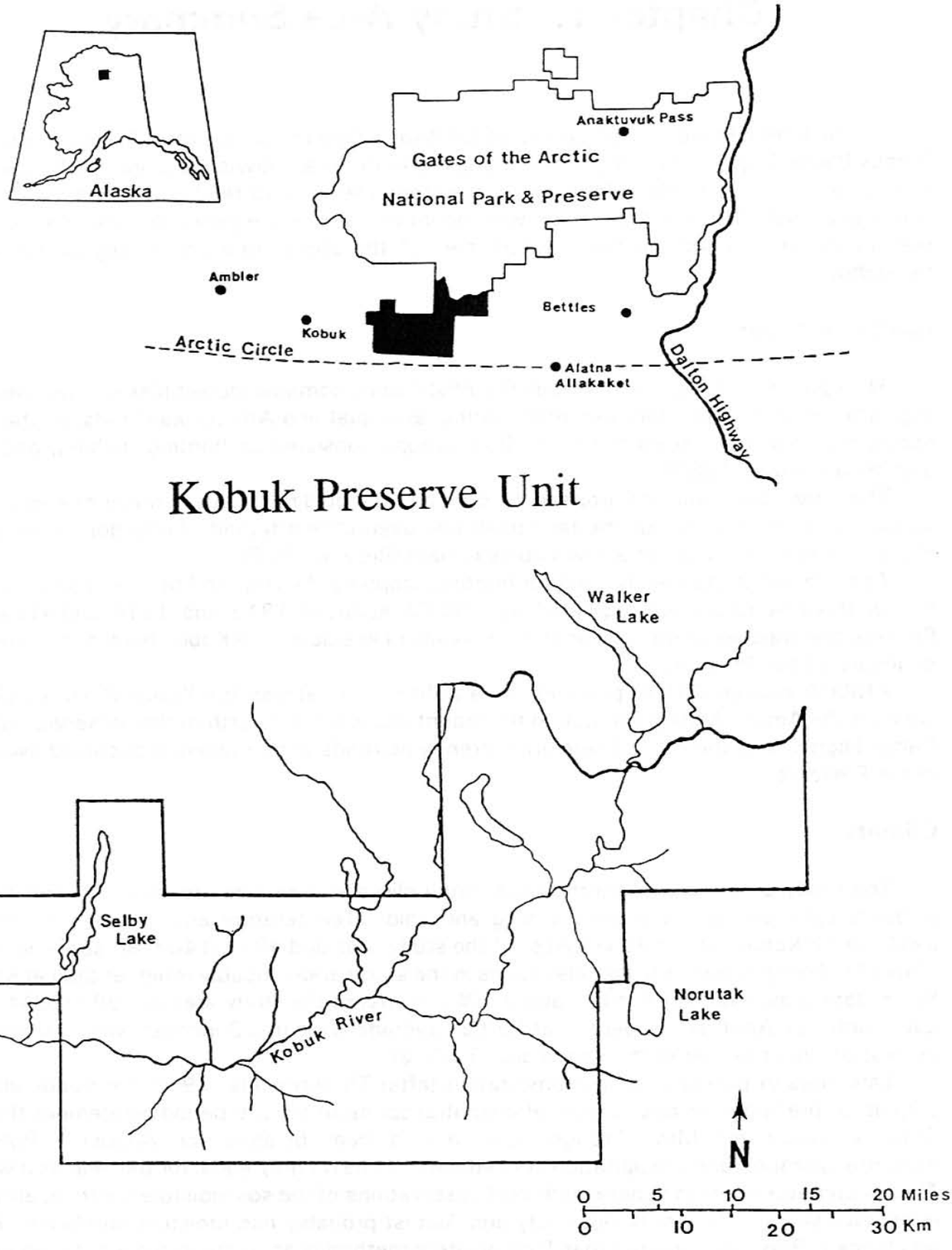


Fig. 1. Study area location.

TABLE 1.--MONTHLY TEMPERATURE AND PRECIPITATION AT KOBUK, ALASKA, 1953-54, 64-79 (Leslie, 1989) and potential evapotranspiration estimated by the Thornthwaite (1948) method)

Month	Mean Temperature, C	Mean Precipitation, cm	Estimated Evapotranspiration, cm
Jan	-23	1.6	0
Feb	-23	1.0	0
Mar	-18	1.7	0
Apr	-8	1.5	0
May	4	2.0	4.6
Jun	12	4.5	10.5
Jul	14	8.2	11.8
Aug	12	8.7	9.6
Sep	6	7.0	4.7
Oct	-7	2.1	0
Nov	-16	2.4	0
Dec	-23	1.7	0
Annual	-6	42.1	41.2

TABLE 2.--SNOW DEPTHS AND SNOW WATER EQUIVALENTS AT BETTLES, ALASKA, 1961-1990 (USDA-SCS, 1992)

Date	1 Feb	1 Mar	1 Apr	1 May
Snow Depth, cm	66	79	81	51
Snow Water Equivalent, cm	13	16	18	14

Geology

The study area is located on the juncture between two major geologic regions or terrains: the Angayucham and Arctic Alaska terrains (Mull, 1982; Mull and Adams, 1989). The former covers most of the study area and consists (within the study area) of mafic and andesitic volcanic rocks; and mudstone, graywacke, and conglomerate derived from volcanic rocks (Patton and Miller, 1966; Patton, 1973). These rocks probably formed in an oceanic island-arc environment similar to the present-day Aleutians (Mull and Adams, 1989). The Arctic Alaska terrain is present in the northern part of the study area and consists (within the study area) of phyllite and small areas of limestone (Patton and Miller, 1966; Nelson and Graybeck, 1980). It formed under continental (including marine continental shelf) conditions. The two terrains were brought together by tectonic plate movements. Collision of the two terrains is thought to be the primary cause of uplift in the Brooks Range (Mayfield et al., 1983; Mull, 1982; Mull and Adams, 1989). Bedrock in the study area has been extensively folded, faulted, and metamorphosed.

Bedrock is exposed in the study area only in the hills and locally along the Kobuk River. Lower mountain slopes and valley bottoms are covered with unconsolidated sediments: loess, colluvium, glacial till, and stream deposits (Hamilton, 1981; Karlstrom et al., 1964).

The upper Kobuk valley has been covered repeatedly by valley glaciers originating in the Brooks Range (Fernald, 1964; Hamilton, 1982; Hamilton et al., 1986). Rocks in the glacier source areas are schist and gneiss, in addition to the types listed previously for the study area proper (Nelson and Grybeck, 1980). Glacial deposits of three different ages are found in the study area (Karlstrom et al., 1964). The terminology for glaciations used by Fernald (1964) for the Kobuk Valley just west of the study area will be followed here.

The oldest glaciation, the Kobuk Glaciation, covered the lowlands of the entire study area. These deposits (map units Ke, Ko, and Kw; see the Detailed Map Unit Descriptions in Chapter 3) have been modified by subsequent weathering and erosion to the point where no typical moraine topography (e.g., closed depressions, hummocky topography) persists. Kobuk glacial deposits are covered by more than 1 m of loess over most of the study area. Exposures of Kobuk glacial deposits along the Kobuk River in the study area are mixtures of till and outwash in terrace-like deposits similar to those described by Fernald (1964). The Kobuk Glaciation is older (probably much older) than the range of radiocarbon dating - 40,000 years (Hamilton, 1982). These deposits are cut by an east-west fault between the Kobuk River and Angayucham Mountains, indicating movement along the fault after the glaciation.

The Ambler Glaciation occurred after the Kobuk Glaciation and was less extensive (see Plate 1: "Physiographic Map of the Kobuk Preserve Unit"). It covered roughly half of the lowlands in the study area. Typical morainal topography of closed depressions and hummocks is still visible on some deposits of the Ambler glaciation (map units Ae and Ah). Judging from the freshness of the topography, the Ambler Glaciation is much younger than the Kobuk Glaciation, although still beyond the range of radiocarbon dating (Hamilton, 1982). The older river terrace map unit (To) probably correlates to the Ambler Glaciation. Ambler glacial deposits have a thinner loess cover than deposits of the Kobuk Glaciation, though loess is more than 0.5 m thick in most places.

The youngest glacial deposits in the study area are from the Walker Lake Glaciation. Ice from this glaciation reached the study area only in a small area north of Nutuvukti Lake (map unit Nu). This moraine has very hummocky topography with many closed depressions and very little loess cover. The Walker Lake Glaciation probably took place between 10 and 30 thousand years ago (Hamilton, 1982). Younger terrace deposits (map unit Td) may be outwash from this glaciation (Hamilton, 1981).

Ice from all of the above glaciations also flowed over areas of bedrock, removing previously accumulated deposits, smoothing the bedrock surface, and leaving a thin layer of glacial sediment. These surfaces were subsequently modified by slope processes for varying lengths of time, depending on the time of the last glaciation. Bedrock areas overridden by the Kobuk (map unit Ck) and Ambler (map unit Ca) glaciations have been weathered and the weathering products transported downhill by slope processes. The result is rather long hillslopes covered by a mixture of colluviated local bedrock, glacial till (identified by erratics: stones of rock types not found as bedrock in the vicinity), and loess, with a few outcrops of bedrock. A small bedrock region overrun by Walker Lake ice north of Nutuvukti Lake (not visited in this study) presumably has thin patchy till over fresh bedrock. Hamilton, 1981, mapped this area as bedrock.

Slope deposits (colluvium) are widespread in the study area. Most are mixtures of weathered local bedrock, glacial deposits, and loess. This material has probably been transported by flowing water (in the numerous small ephemeral streams that occur on these slopes), creep, and solifluction. Solifluction is currently active only locally, mainly above treeline in the study area; it was probably widespread in the past (see the "Environmental

History" section of this chapter). Exposures of colluvial deposits in map unit Ca showed oriented stones, typical of solifluction deposits (Benedict, 1970). While slope deposits occur throughout the study area, only on mountain slopes do they occur in areas large enough to delineate as a separate map unit (map unit Cs). Elsewhere they are components of complex map units.

River deposits occur everywhere along streams in the area, except where the streams are downcutting (for example, in Upper and Lower Kobuk Canyons). The channel patterns of the Kobuk and Reed Rivers combine features of meandering and braided streams. Some small streams in map unit Fc have a meandering channel pattern. River deposits (map units Fr and Fc) are sand and gravel mantled with silt and sand; the fine-grained surface layer is thin or non-existent on active gravel bars and thicker on older, higher surfaces.

Permafrost

The study area lies near the boundary between continuous and discontinuous permafrost (Pewe, 1975; Ferrians, 1965). Though it is impossible to completely describe the permafrost distribution without deep borehole data, the results of this study suggest that permafrost is extensive, but discontinuous in the study area. Permafrost occurs near the surface in most areas with fine-grained surface deposits (loess, colluvium, or alluvium). Permafrost was not observed on some steep slopes (particularly those with a south aspect); on gravelly parts of moraines, terraces, and flood plains; in some recently burned areas; and on dry, convex sites (i.e., edges of escarpments, hilltop knobs). My failure to observe permafrost on many of these sites could be due to the fact that the active layer (depth of thaw) on dry sites is deeper than my sampling depth (1.5 m, or less in rocky soils). However, the flood plains and perhaps some other sites do in fact probably lack permafrost.

Though south-facing slopes are more likely to lack near-surface permafrost than north-facing slopes, the contrast here is less pronounced than in central and eastern Interior Alaska. In the Kobuk area, the rather cloudy climate reduces the contrast between incoming solar radiation on north and south slopes.

Fire has a major effect on the distribution of permafrost in Interior Alaska (Dyrness, 1982; Clark and Kautz, in press; Viereck, 1973, 1982; Viereck and Schandelmeier, 1980). Mean annual soil temperatures warm appreciably after fire and the active layer becomes thicker. Permafrost does not disappear entirely after fire on typical Interior Alaska sites such as those reported in Viereck (1982).

Frequently cited reasons for post-fire warming include removal of the insulative moss mat, reduction of shading by vegetation, and reduced albedo of the burned surface (Viereck, 1982). The organic mat may also lower the mean annual soil temperature by its effect on the "thermal offset" (Burn and Smith, 1988; Goodrich, 1978). The organic mat also damps seasonal temperature fluctuations.

Observations of burns as a part of this study showed that active layers thicken to more than 1.5 m. on some, but not all, burned areas. Relatively well-drained, slightly convex, mid- to upper slopes are most likely to thaw deeply after fires. Wetter sites in concavities usually show little change in active layer thickness after fire.

The distribution of permafrost along rivers in the study area is probably affected by alluvial deposition, plant succession, and the direct warming effect of the river water. The layer of unfrozen river water in the winter prevents freezing temperatures from penetrating into the ground in the river bed. This effect is probably less important in the Kobuk area than in the arctic, as the other two factors also keep the river bed area thawed. Alluvial deposition has a two major indirect effects on permafrost occurrence. First, deposition hinders the growth of moss and formation of an organic mat, thereby keeping the soil warmer. This is

one reason that deciduous forest and brushy areas along the river often lack permafrost. However, alluviation at a slower rate, such as occurs on slightly higher surfaces, favors permafrost formation in the long run. Because the silty sediment from overbank deposition has a high water-holding capacity, this sediment will have a greater thermal offset than drier gravels would, and a moister, more hospitable environment is created for accumulation of a thick organic mat (which also has a high thermal offset). Thus slightly higher, older surfaces that have accumulated more silt through overbank flood deposition are likely to have permafrost. Plant succession along rivers also affects permafrost distribution (Viereck, 1970). As succession progresses, the surface becomes more shaded and the organic mat builds up, leading to colder mean annual soil temperatures and more likely occurrence of permafrost.

Landforms which owe their existence to permafrost in the study area include earth hummocks, mudboils, palsas, peat plateaus, and thermokarst pits. The first two features form as a result of soil movement during annual freeze-thaw cycles (Mackay, 1980; Shilts, 1978). Earth hummocks are widespread in the study area, while frost boils occur mainly on the tundra. Palsas are frozen hillocks in otherwise unfrozen wetlands; the elevation difference between the hillocks and hollows is due to the presence of ground ice under the hillocks (Zoltai, 1972; Zoltai and Tarnocai, 1971). Palsas occur in the wetland south of Nutuvukti Lake (map unit Tw). Peat plateaus are extensive, level surfaces with a thick peat cover; like palsas, they are elevated above associated thermokarst pits by segregated ice (Zoltai, 1972; Zoltai and Tarnocai, 1975). Ice-wedge polygons are rare in the study area, though wedge ice is probably present at depth on the older landforms (Kobuk and Ambler moraines).

Thermokarst pits form by subsidence due to melting of ground ice. They occur throughout the study area, wherever sufficient segregated ground ice is present. Segregated ground ice is most common in silty sediments. Thus thermokarsting is most common on thick loess or colluviated loess on old moraines. Thermokarsting is initiated by disturbance of the surface (by fire, treethrow, traffic, etc.) or accumulation of water (which is a good absorber of heat). Once a depression forms, it often continues to expand by wave action (in large pits), melting of ice exposed in cutbanks, and continued warming by the water in the depression.

Many ponds and small lakes on Ambler moraines in the study area (mainly in map unit Aw) appear to have formed originally due to the irregular topography of the glacial moraines. However, because ground ice formed in the areas surrounding the ponds, the ponds were able to expand by thermokarsting. As a result, sediment eroded from the banks collected in the ponds and most are currently quite shallow.

Since loess is generally a meter or two thick in the study area, the measured subsidence due to melting of segregated ground ice in the loess is also on this scale. Thus while thaw of ground ice does constitute a significant engineering hazard, the catastrophic subsidence (i.e. tens of meters) such as been observed by the author in other parts of Interior Alaska and described in Siberia (Czudek and Demek, 1970) is unlikely.

Environmental history

The present environment of the Kobuk Preserve Unit has been molded in part by events in the past when the environment was quite different. The fact that glaciers once covered all of the lowlands in the study area in itself demonstrates the magnitude of environmental change that has occurred. The changes are important for the glacial deposits that they produced (described in the "Geology" section) and for the events that occurred beyond the reach of glaciers under a climate different from today's.

During the Pleistocene glaciations, Interior Alaska was apparently a cold, dry place with treeless vegetation that resembled both modern tundra and steppe (Anderson, 1988; Brubaker et al., 1983; Edwards et al., 1985; Guthrie, 1990; Hopkins, 1982). Cold temperatures and

lack of snow facilitated the formation of polygonal ice wedges, and loess deflated from glacial river beds was deposited in many areas (Pewe, 1975). As a result, massive ground ice is present in thick, silty Pleistocene deposits in various places in interior Alaska. Because most of the study area was unglaciated during the Walker Lake Glaciation, and roughly half was unglaciated during the Ambler Glaciation also, massive ground ice may have formed and still be present in the thick loess and colluvium of unglaciated areas. The absence of loess on Walker Lake-aged deposits in the study area indicates little loess deposition in the Holocene.

Another effect of past environments is that solifluction was apparently more widespread in the past. Solifluction is the flow of wet soil downslope over a frozen layer. Solifluction currently occurs locally above treeline in the mountains of the study area. The slopes below treeline are not conducive to solifluction because the active layer, which thaws seasonally and is thus capable of flow, is mostly slightly decomposed peat. This peat is lightweight even when moist, and thus cannot supply the necessary downslope shear stress to cause flow. However, during glacial times there was little moss and probably much less organic matter on the soil surface, and thus solifluction was probably more active. Many of the rather gentle, concave hillslopes in the study area probably formed by solifluction in the past.

The study area has a few small hilly areas of fine sand that are probably dunes; none are large enough to map at the scale used here. These dunes probably formed during the more arid climate of the Pleistocene glaciations, when dunes formed in numerous localities around Alaska (Pewe, 1975). The dunes in the study area are currently completely vegetated.

Hydrology

Hydrologic information for the study area is limited to short-term observations of flow in the Kobuk River (Childers and Kernodle, 1983). However, some conclusions may be drawn by applying studies from other parts of Interior Alaska (Carey, 1973; Haugen et al., 1982; Hopkins et al., 1955; Kane and Hinzman, 1988; Kane et al., 1989; Sloan et al., 1976; Williams, 1970).

The mean monthly discharge of the Kobuk River at Ambler (about 100 km west of the study area) peaks in June as a result of snowmelt. High flow occurs occasionally in the summer due to runoff from heavy rainstorms. Flow drops off rapidly in the fall, and maintains a fairly constant low level from November to April (Childers and Kernodle, 1983).

In most soils with permafrost in the study area, the mineral soil is usually saturated down to the frozen soil and thus capable of little additional moisture storage. Thus, watersheds tend to react quickly with runoff after rain events (Haugen et al., 1982). Runoff on these soils occurs mainly through the permeable organic mat. Spring snowmelt water in Interior Alaska is usually dark colored due to a high organic matter content.

Slopes with thick organic mats and permafrost near the surface have some unique hydrologic characteristics. These slopes show numerous small parallel lines, which are visible on aerial photographs due to their slightly different vegetation. These lines are interpreted as minor runoff channels (Kane et al., 1989). The organic mat is generally continuous across these channels, and they apparently carry little suspended mineral matter. Because these channels do not erode the mineral soil, they apparently do not tend to downcut and link up into the dendritic drainage system typical of non-permafrost areas.

Larger ephemeral streams in the area breach the organic mat, carry a mineral load, and have incised to form the more familiar dendritic drainage pattern.

Groundwater recharge, movement, and discharge is restricted in permafrost regions by impermeable frozen soil (Williams, 1970). For this reason, there are relatively few groundwater-discharge wetlands in the study area. Most wetlands are due instead to perching of water on top of frozen soil, or by surface runoff into shallow depressions.

One important exception is the groundwater recharge-discharge system consisting of the moraine north of Nutuvukti Lake and the adjacent fen. The moraine is coarse-grained, has little loess cover, and appears to be mostly permafrost-free. Groundwater infiltrates into the moraine (probably dominantly in the spring, when snowmelt collects in the numerous small closed depressions) and then is discharged into the fen below. As one would expect, the pH of water in the fen is the same as that of the moraine sediments (5.6). Discharge is sufficiently strong to keep the wetland free of permafrost and produce a northern ribbed fen (National Wetlands Working Group, 1987), a relatively rare wetland type in northern Alaska. Around the margins of this wetland are palsas (described above under "Permafrost"). Here the discharge of relatively warm water is slower, allowing part of the wetland soils to freeze into palsas.

Groundwater discharge occurs locally elsewhere into minerotrophic (nutrient-rich) wetlands in the study area, though nowhere as actively as in the Nutuvukti fen. These wetlands occur most often on gravelly terrace sediments (map unit Tw) in footslope positions. The recharge that feeds these wetlands probably occurs through coarse-grained, unfrozen crests of moraines and bedrock hills, through unfrozen bottoms of ephemeral ponds on moraines, and through small upland streambeds.

Other evidence of groundwater movement in the study area is pingos, which occur in several places on mountain footslopes. Water infiltrates through taliks on the mountain (exactly where is uncertain) and moves under pressure under the permafrost, feeding the growth of a subsurface body of ice on the footslope. The result is a pingo of the open-system type (Hamilton and Curtis, 1982; Holmes et al., 1968).

Icings occur in cold climates where water reaches the surface and freezes, building up layer-by-layer (Alekseyev, 1987) Icings are common where groundwater movement occurs near the surface during the winter (Carey, 1973). Icings occur naturally near springs, locally along rivers, and in small drainages where surface flow ceases but shallow groundwater continues to move in channel sediments. Icing, together with flooding, is probably responsible for the treeless, brushy vegetation of small stream flood plains in the study area.

Two icings in the study are large enough and persistent enough to be mappable on 1:250,000-scale, late spring and summer Landsat images (Dean, 1984). These icings occur in the floodplain of Angayakachak Creek and a tributary of that creek in the far western part of the study area, south of Lake Selby (Fig. 2); they are in map unit Ae, component 4.

Roads tend to increase icing formation by obstructing normal water movement. Unless appropriate measures are taken, ice can overwhelm roads on slopes traverses and at stream or river crossings.

Soils

Most soils in the study area are weakly weathered and have a surface accumulation of organic matter; many also have permafrost near the surface and are wet due to perching of water above the permafrost. These properties are due to soil formation in a cold climate on generally young parent materials. Soils are described in greater detail in Chapters 3, 4, and 6.

Soils on fine-grained materials (loess and silty colluvium) in the study area generally have a surface organic layer 10 to 50 cm thick, permafrost within one meter of the surface, and mineral soil that is grayish due to biochemical reduction while in a saturated state. Thin lenses of nearly pure ice are often present near the permafrost table. Cryoturbation is

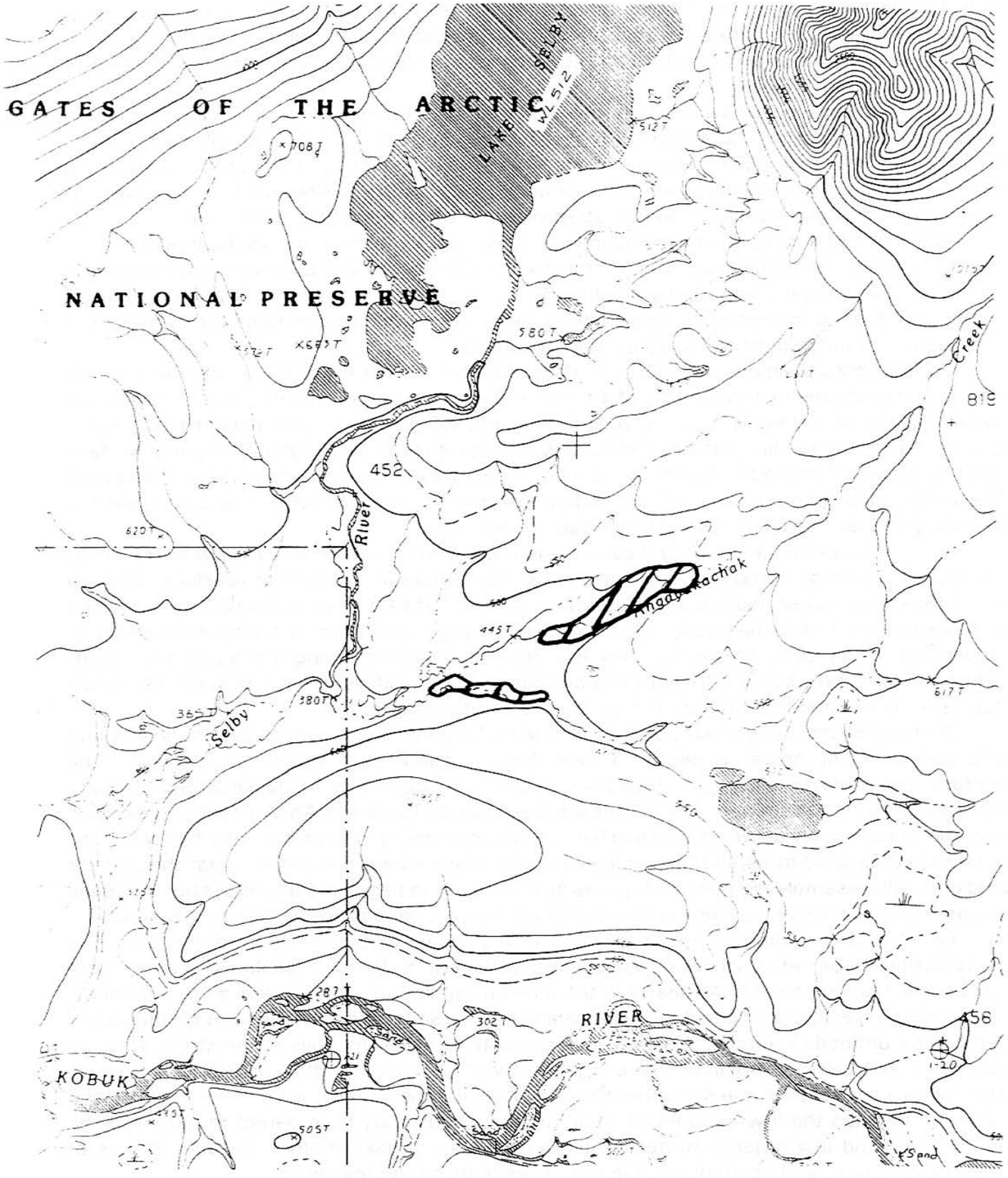


Fig. 2. Location of large, persistent stream icings. Hughes D-6 quadrangle, scale 1:63,360. Icings are near 66 deg 49 min N, 155 deg 40 min W. Boundaries were inferred from vegetation patterns on July, 1979 color-infrared aerial photographs, using Dean's (1984) map as a guide.

indicated by irregular buried masses of organic-rich material in the soil profile and by the presence of earth hummocks. In tundra areas, cryoturbation also produces mudboils on the surface. These soils usually are classified as Pergelic Cryaquepts or Histic Pergelic Cryaquepts (Soil Survey Staff, 1992).

Different soils occur where fires have altered the thermal properties of the soils by destroying the vegetation and some of the surface organic soil layer (Moore and Ping, 1989). In these soils, the permafrost table descends to a depth of more than 1.5 m, the soil becomes drier, and the mineral soil becomes partly or completely oxidized. Irregular buried masses of organic-rich material from previous cryoturbation are often present in these soils.

The changes in soils due to fire described above are common in the study area but by no means the rule. Many permafrost soils maintain a high permafrost table and wet conditions after fire. Deep thaw is apparently most likely on sites with fine-grained materials that were rather well drained to start with; here disturbance by fire is sufficient to force the system over a threshold to much drier and warmer soil conditions.

Soils on dry sites generally lack permafrost within 1.5 m of the surface regardless of fire effects, and biochemical reduction of the mineral soil is weak or absent. Such soils occur where the loamy surface layer is thin over coarse-grained subsoil, and on distinct topographic convexities such as hill crests and shoulders. These soils usually have an organic surface layer less than 10 cm thick. B horizons usually show some oxidation, and weak mottling near the surface (indicating occasional wet conditions) is sometimes present. These soils usually are classified as Typic Cryochrepts or Aquic Cryochrepts.

Soils with evidence of podzolization are occasionally encountered on the dry sites, particularly in sandy materials. The only soil study to date in this part of Alaska (Ugolini et al., 1981) emphasized podzolization. However, only 23 of 843 soil profiles (2.7%) described in this study were classified as Spodosols. Apparently, podzolization can occur here, but only under ideal conditions. Frozen soil probably prevents leaching during the spring snowmelt, when the greatest excess of moisture is available. The moisture deficits or weak surpluses typical of the summer period are not conducive to podzolization.

On flood plains, soils usually contain thin buried organic layers within stratified sand and silt, and sand and gravel at depth. Where flooding still occurs at least occasionally, the surface organic layer is generally less than 10 cm thick, permafrost is lacking, and soils are not saturated in the summer. These soils are classified as Typic and Aquic Cryofluvents. Soil material is essentially unweathered and has little or no mottling. Less frequently flooded areas with thicker organic mats and thicker loamy surface layers have permafrost near the surface and generally resemble the permafrost soils described at the beginning of this section (Pergelic Cryaquepts). However, evidence of cryoturbation is uncommon in the flood plain soils.

Fertility of dry soils in the study area is high only where fresh mineral material is periodically deposited on the soil surface. Cryofluvent soils on floodplains with at least occasional flooding have a pH near 7 in the mineral soil and usually support a lush, nutrient-demanding assemblage of deciduous shrubs and herbs. Soils with similar parent materials but located on unflooded terraces (as well as essentially all other dry soils in the study area, on moraines and bedrock uplands) have a pH between 5 and 6 in the mineral soil. These unflooded soils support mainly nutrient-conserving evergreen trees, ericaceous shrubs, and lichens. Perhaps the low cation-exchange capacity of the clay-poor parent materials in the study area, and low organic-matter contents of the soils make them vulnerable to loss of fertility with mild acidification, even in the absence of strong leaching.

Fertility of wet soils in the study area is also usually low, though in this case because rooting is restricted (by wetness and frozen soil) to highly acidic (pH <5) organic surface horizons. Many of the same nutrient-conserving plants that occur on dry sites occur here also, although mosses and sedges are much more abundant on the wet sites. Exceptions to

the low fertility rule on wet sites occur where nutrients are introduced by groundwater discharge or flooding, such as on flood plains of small streams and in groundwater-fed wetlands.

Vegetation

The vegetation of the study area is dominantly taiga (boreal forest), with tundra occurring in the mountains above about 600 m (2000 feet) elevation, and in the lowlands at the west end of the study area. Vegetation has been studied elsewhere on the south slope of the Brooks Range outside of the study area (Christiansen, 1988; Cooper, 1989; Lev, 1987; Melchior, 1976; Odasz, 1983). The vegetation of the study area is summarized below and described in greater detail in Chapters 3 and 7.

Open black spruce (*Picea mariana*) forest is widespread in the Preserve. It occurs nearly everywhere except active flood plains, wetlands too wet for trees, steep mountain slopes, and tundra areas. Black spruce may be accompanied by paper birch (*Betula papyrifera*) or aspen (*Populus tremuloides*), particularly on drier sites and recent burns. The understory of the black spruce forests is various low shrubs, such as *Betula glandulosa*, *Vaccinium vitis-idaea*, *V. uliginosum*, and *Ledum palustre*. On moist, concave slopes the ground is covered by mosses, dominantly *Hylocomium splendens, Pleurozium schreberi*, and *Sphagnum* spp.; *Polytrichum* spp. is common after fires. On drier sites the ground cover is usually dominated by *Cladina* spp. lichens rather than mosses, probably due to the greater drought resistance of lichens (Rowe, 1984).

White spruce (*Picea glauca*) forest occurs on two distinctly different types of sites in the study area: flood plains, and steep mountain slopes with east, south, or west aspect. In both cases the understory is dominated by alder (*Alnus crispa*) and stands are not extensive.

Flood plain areas that are occasionally to frequently flooded and disturbed by floating ice in the spring have brush consisting of willow (*Salix*) and poplar (*Populus balsamifera*); the latter also forms forests successional to white spruce forests on less disturbed sites. Rarely flooded areas on floodplains have the moist black spruce forest described above. Flood plain vegetation shows many similarities with that of southern Interior Alaska (Viereck, 1970; Van Cleve et al., 1986). One notable difference is the low canopy closure of most flood plain white spruce forests in the study area, which are best described as alder thickets with a sparse superstory of large spruce. Also, the alder understory here is not an earlier successional stage being replaced by white spruce; dense alder is present in stands with very old spruce and persists into later-successional stage black spruce forests.

Wet depressions in the study area often have a carpet of *Sphagnum* moss with sedges (*Carex*). Nearly level areas on moraines that are too wet for trees generally have tussocks of cottonsedge (*Eriophorum*) and pillows of *Sphagnum* moss, with a sparse cover of same low shrubs listed above for black spruce forests.

Lowlands in the western part of the study area have a mosaic of forested and unforested vegetation referred to here as tundra-forest ecotone (map units Ae and Ke). In the ecotonal area, nearly treeless patches occur on gentle slopes as well as level areas, and trees within or on the fringes of these patches show evidence of damage by windblown snow. Forest is restricted to dry or wind-protected sites. This situations is in contrast to the nearly completed forested lowlands further east; here only very wet, nearly level areas are treeless, and wind damage is uncommon.

Unforested areas in the ecotonal area have cottonsedge (*Eriophorum*) tussocks on wetter sites and low shrubs with lichens on better-drained sites; the latter have discontinuous vegetation due to mudboils.

Vegetation on mountain ridges above treeline is mainly open low scrub with fruticose lichens. In alpine areas, significant areas are occupied by rock outcrops and rock rubble with vegetation of only crustose lichens. Treeless alder and *Vaccinium uliginosum* scrub occur on mountain slopes below treeline that are disturbed by avalanches.

Vegetation in the study area is adapted to periodic wildfire (Foote, 1983; Christiansen, 1988). Black spruce has semiserotinous cones, that is, cones adapted to release seed after fires (Viereck, 1973). Thus many black spruce forests in the study area have formed from seed after fire. Birch and aspen regenerate from stump sprouts after fire, and colonize burns faster than black spruce if they were present in significant density before the fire. Species abundance is altered by fire, but vascular species composition is little altered. Mosses and lichens show a more orderly succession after fire (Black and Bliss, 1978). *Polytrichum* moss and *Cladonia* lichens dominate at early successional stages, while feathermosses (*Hylocomium splendens* and *Pleurozium schreberi*) and *Cladina* lichens tend to take over later.

Fire history and behaviour

Wildfires have a major effect on the natural environment of the study area. Unpublished Bureau of Land Management records (1956-1994) show that large fires occurred in the Kobuk Preserve Unit in 1991, 1986, 1978, 1974, 1971, 1969, 1964, and 1959 (Table 3; Plate 2). Numerous small fires (less than 200 ha) also occurred during this period. Our study indicates large burns in the Norutak Hills region sometime during the decade prior to 1956 (Plate 2). Fires since 1956 show little overlap, suggesting a reduced fire probability during at least the first 30 to 40 years after a burn.

TABLE 3. FIRES IN THE KOBUK PRESERVE UNIT, 1956-1994[1]

Year	Area, acres	BLM fire numbers
1991	19100	B436, B614
1986	1000	A309
1978	1000	8545
1974	1800	8669, 8670
1971	400	8734
1969	36400	9497
1964	300	74
1959	4100	83, 84

[1]Source: unpublished records, USDI-BLM Fire Service, Fairbanks, AK

Wildfire behavior in interior Alaska is known for the major vegetation types (USDI-BLM, 1991; and unpublished material from the Alaska Dept of Natural Resources, Division of Forestry). Fires spread readily in most black spruce forests due to the flammability of the spruce, low shrubs, mosses, and lichens. Fires in black spruce forests are usually carried by the surface fuels, with spruce crowns burning just behind the fire front.

Similar fires can occur in white spruce forests where the understory is like that of typical black spruce forest. However, white spruce forests with alder understory (mainly on flood plains and mountain slopes) rarely burn, probably thanks to the low flammability of the alder brush and lack of ladder fuels on the trees.

Birch and aspen forest are also less fire-prone than black spruce, due to higher moisture content of the vegetation and lack of a continuous dry moss or lichen mat.

Graminoid tussock vegetation is quite fire-prone, thanks to the presence of dead graminoid material. Fires are rare on sparsely vegetated gravel bars and alpine areas, and in wet shrub thickets along small streams.

Wildlife

Sightings and sign (scat, browsed and broken stems) of moose (*Alces alces*) are common in deciduous brush on flood plains of major rivers and the numerous small ephemeral streams. Moose sign is rare in the spruce forest that covers most of the study area. Some increase in moose sign is noted in post-fire regeneration forests, although sign there is never as abundant as on flood plains.

Caribou (*Rangifer tarandus*) are rare in the study area in the summer, but sign indicates use of the preserve in winter. The study area falls within the wintering area of the Western Arctic Caribou herd, although the main wintering grounds for this herd in recent decades have been further west (Pat Valkenburg, Alaska Dept of Fish & Game, unpublished). Sign (scat, grazed lichens, trampled lichens) is most common in dry spruce forest with substantial lichen cover (vegetation site type "Dry terraces and uplands (lichen woodland)", which occurs in patches in many map units throughout the Preserve) and on lichen-rich lowland tundra areas (in the western part of the preserve, map unit Ke, component 1).

Sign of bear (*Ursus americanus* and *U. arctos*) is most conspicuous in August along the Kobuk River when dead salmon wash up on the shore. Bears presumably also use various forest and tundra areas that are rich in berries (*Empetrum nigrum, Vaccinium uliginosum, V. vitis-idaea, Rubus chamaemorus*), though sign is rare in these areas.

Wolves (*Canis lupus*) were heard and sighted frequently along the Kobuk River. Various small and medium-sized predatory mammals are known to occur in the preserve: weasels (*Mustela erminea, M. nivalis*), mink (*Mustela vison*), marten (*Martes pennanti*), river otter (*Lutra canadensis*), wolverine (*Gulo gulo*), red fox (*Vulpes fulva*), and lynx (*Lynx canadensis*). Sightings and sign in summer are rare, however. Otters were sighted on the Walker Lake outlet stream below the rapids, where groundwater discharge probably maintains open water in the winter.

Beavers (*Castor canadensis*) inhabit quiet backwaters of the Kobuk and Reed Rivers, and Beaver Creek. Snowshoe hares (*Lepus americana*) were present but uncommon during field sampling.

Studies of small mammals in the preserve and nearby (Shelli Swanson, Gates of the Arctic National Park, unpublished data) indicate that redbacked voles (*Clethrionomys rutilis*) and yellow-checked voles (*Microtus xanthognathus*) dominate. Masked, pygmy, and dusky shrews (*Sorex cinereus, S. hoyi*, and *S. monticolus*), brown lemmings (*Lemmus trimucronatus*) and northern bog lemmings (*Synaptomys borealis*) are also present.

Microtine sign (diggings, runways, clipped graminoid material, scat) is common, particularly in moist black spruce forest with moss ground cover. Microtines seem to prefer sloping sites, probably for their better drainage. Voles are probably attracted to moist, mossy sites by berries and cottonsedge (*Eriophorum*). Microtine sign increases noticeably as the summer progresses and the current-year young add to the population.

A wide variety of birds occur in the preserve during the summer (Table 4). A few

generalizations about bird habitat use can be drawn from notes taken during this study. Shallow water for dabbling ducks (Northern shoveler and American widgeon) and Red-necked Phalaropes is found mainly in ponds of unit Aw. A number of species occurred mainly near rivers (map units Fr and Fc): Red-throated Loons, Ospreys, Bald Eagles, Semipalmated Plovers, Gulls, Belted Kingfishers, and Bohemian Waxwings. Other waterfowl species are most common on large lakes. Snipes were usually found in the wetlands of map unit Tw, and the single sighting of a Short-eared Owl also occurred there. Whimbrels were observed on the tussock tundra of map unit Ae. Northern Waterthrushes and Lincoln Sparrows were observed mainly in deciduous brush on small stream flood plains.

More information on the value of the map unit components to wildlife is given in the Detailed Map Unit Descriptions (Chapter 3) and Table 16 (Chapter 5) of this report.

TABLE 4.- BIRDS OBSERVED IN THE KOBUK PRESERVE UNIT*

Order Gaviiformes, Family Gaviidae	
Red-throated Loon	*Gavia stellata*
Pacific Loon	*Gavia pacifica*
Common Loon	*Gavia immer*
Order Podicipediformes, Family Podicipedidae	
Horned Grebe	*Podiceps auritus*
Red-necked Grebe	*Podiceps grisegena*
Order Anseriformes, Family Anatidae	
Greater White-fronted Goose	*Anser albifrons*
Canada Goose	*Branta canadensis*
Northern Shoveler	*Anas clypeata*
American Wigeon	*Anas americana*
Lesser Scaup	*Aythya affinis*
Oldsquaw	*Clangula hyemalis*
Surf Scoter	*Melanitta perspicillata*
Red-breasted Merganser	*Mergus serrator*
Order Falconiformes, Family Accipitridae	
Osprey	*Pandion haliaetus*
Bald Eagle	*Haliaeetus leucocephalus*
Northern Harrier	*Circus cyaneus*
Sharp-shinned Hawk	*Accipiter striatus*
Northern Goshawk	*Accipiter gentilis*
Red-tailed Hawk	*Buteo jamaicensis*
Rough-legged Hawk	*Buteo lagopus*
Order Galliformes, Family Phasianidae	
Spruce Grouse	*Dendragapus canadensis*
Order Gruiformes, Family Gruidae	
Sandhill Crane	*Grus canadensis*

Order Charadriiformes	
Family Charadriidae	
Semipalmated Plover	*Charadrius semipalmatus*
Family Scolopacidae	
Lesser Yellowlegs	*Tringa flavipes*
Solitary Sandpiper	*Tringa solitaria*
Wandering Tattler	*Heteroscelus incanus*
Spotted Sandpiper	*Actitus macularia*
Whimbrel	*Numenius phaeopus*
Least Sandpiper	*Calidris minutilla*
Common Snipe	*Gallinago gallinago*
Red-necked Phalarope	*Phalaropus lobatus*
Family Laridae	
Long-tailed Jaeger	*Stercorarius longicaudus*
Mew Gull	*Larus canus*
Herring Gull	*Larus argentatus*
Glaucous Gull	*Larus hyperboreus*
Arctic Tern	*Sterna paradisaea*
Order Strigiformes, Family Strigidae	
Great Horned Owl	*Bubo virginianus*
Northern Hawk Owl	*Surnia ulula*
Great Gray Owl	*Strix nebulosa*
Short-eared Owl	*Asio flammeus*
Order Coraciiformes, Family Alcedinidae	
Belted Kingfisher	*Ceryle alcyon*
Order Piciformes, Family Picidae	
Three-toed Woodpecker	*Picoides tridactylus*
Order Passeriformes	
Family Tyrannidae	
Olive-sided Flycatcher	*Contopus borealis*
Say's Phoebe	*Sayornis saya*
Family Hirundinidae	
Tree Swallow	*Tachycineta bicolor*
Bank Swallow	*Riparia riparia*
Cliff Swallow	*Hirundo pyrrhonota*
Family Corvidae	
Gray Jay	*Perisoreus canadensis*
Common Raven	*Corvus corax*
Family Paridae	
Boreal Chickadee	*Parus hudsonicus*

Family Muscicapidae	
Ruby-crowned Kinglet	*Regulus calendula*
Gray-cheeked Thrush	*Catharus minimus*
Swainson's Thrush	*Catharus ustulatus*
American Robin	*Turdus migratorius*
Varied Thrush	*Ixoreus naevius*
Family Motacillidae	
American Pipit	*Anthus rubescens*
Family Bombycillidae	
Bohemian Waxwing	*Bombycilla garrulus*
Family Emberizidae	
Orange-crowned Warbler	*Vermivora celata*
Yellow Warbler	*Dendroica petechia*
Yellow-rumped Warbler	*Dendroica coronata*
Blackpoll Warbler	*Dendroica striata*
Northern Waterthrush	*Seiurus noveboracensis*
Wilson's Warbler	*Wilsonia pusilla*
American Tree Sparrow	*Spizella arborea*
Savannah Sparrow	*Passerculus sandwichensis*
Fox Sparrow	*Passerella iliaca*
Lincoln's Sparrow	*Melospiza lincolnii*
White-crowned Sparrow	*Zonotrichia leucophrys*
Dark-eyed Junco	*Junco hyemalis*
Rusty Blackbird	*Euphagus carolinus*
Family Fringillidae	
Pine Grosbeak	*Pinicola enucleator*
White-winged Crossbill	*Loxia leucoptera*
Redpoll	*Carduelis spp.*

*Terminology follows Gibson (1993).

Chapter 2: Methods

Cartographic

The detailed map units were designed to encompass areas with a consistent pattern of landforms, soils, vegetation, and landscape-forming processes. Map unit boundaries were drawn stereoscopically on 1:63,360 paper orthophoto quadrangles by interpretation of 1:60,000 color-infrared aerial photographs and 1:63,360 topographic maps. Boundaries were then transferred to pin-registered mylar overlays of 1:63,360 mylar topographic maps, and lines were adjusted to the stable-base topographic maps. The boundaries generally follow major landforms, with vegetation used as a secondary guide. The minimum sized delineation is generally about 1 square kilometer.

The physiographic map units (Plate 1) were distinguished on the basis of major landforms and the geologic age of moraine deposition (Karlstrom et al., 1964; Hamilton, 1981).

Field: Land properties

Fieldwork was done in late June, July, and August of 1992 and 1993 by David K. Swanson (of NRCS) and Donna Devoe (of NPS). Data on surficial geologic materials, soils, and vegetation were collected on transects placed deliberately in representative areas of each map unit. The transects were generally 1-3 km long with 6-20 stops. Soils were examined using a shovel and bucket auger; the auger allows observations to a depth of 1.5 m, if rock or frozen material does not prevent excavation.

Two levels of sampling intensity were used on transects. At all stops, the setting was described; the soil was classified and its major features summarized; and the vegetation was classified (Table 5). The vegetation was classified using a modification of the system by Viereck et al. (1992): each stratum was classified to Level III in that system as if it were the dominant stratum.

More data was collected at selected intensive sites (Table 6), in addition to the above data: a complete soil description; estimated plant canopy cover for each species (or, in a few cases, species group or genus; see the footnote to Appendix I) for a roughly circular area within approximately 20 m of the soil pit; basal area, diameter, and age of selected dominant trees; and estimated the time since last fire.

Because shallow soil borings give a limited picture of surficial geologic materials, these materials were also examined in deeper natural exposures (mainly river cutbanks), and inferred by study of geomorphology in the field and on aerial photographs.

Field: Landscape-forming processes

Because processes can rarely be observed directly, processes were identified by observation of their characteristic features. The features associated with major processes were obtained from the literature (Table 7).

TABLE 5.--DATA COLLECTED AT ALL TRANSECT STOPS

Soil and Site

Transect, stop numbers
Mapunit
Date
Soil scientist
Location
- aerial photograph number
- USGS quadgrangle
- latitude (of starting point)
- longitude (of starting point)

Soil classification (Soil Survey Staff, 1992)
Surface soil texture and lower depth (textures from Soil Survey Staff, 1951)
Subsurface textures and lower depths
Elevation
Slope
- steepness
- aspect
- shape

Landform
Position on slope
Geologic material
Organic surface layer thickness
Depth to: bedrock, frozen soil, water table, saturated soil, gleyed matrix, gleyed mottles
Presence of cryoturbation
Presence of buried organic horizons
Flooding frequency: estimated as frequent, >50 years in 100; occasional, 5 to 50 years in 100; rare, <5 years in 100; or none

Vegetation

Botanist
Each major vegetation stratum clasified to Level III in Viereck et al. (1992)

TABLE 6.--DATA COLLECTED AT INTENSIVE TRANSECT STOPS

Soils

Complete soil description: horizons symbols and depths, color, mottles, texture, structure, consistence, pH, roots, horizon boundaries (Soil Survey Staff, 1951)

Vegetation

Time since last fire (<10, 10-50, 50-100, >100 years; or no evidence of fire), from tree corings and BLM fire records

Basal area of trees (by angle gage)

For selected trees: crown class, diameter, age, width of last 10 rings, height

Cover class of litter, soil, rock, water, lichens, and moss. Cover classes are <1, 1-5, 5-25, 25-50, 50-75, >75%

Canopy cover class of each species (or genera if species not separable; Hulten, 1968; Viereck and Little, 1972; Thomson, 1984; Crum and Anderson, 1981; Vitt et al., 1988; see Appendix I). Cover classes are <1, 1-5, 5-25, 25-50, 50-75, >75%

Notes on use by wildlife (USDI-BLM, 1984; Anderson and Currier, 1973; Swanson and Barker, 1991)

TABLE 7.--MAJOR LANDSCAPE-FORMING PROCESSES IN THE STUDY AREA

PROCESS	CHARACTERISTIC FEATURES
Abrasion of plants by windblown snow	Damage to tree branches or lack of branches at snow surface level; flag-form trees (Billings and Mooney, 1968).
Biochemical reduction	Gray soil colors; soil mottling (Rieger, 1983).
Creep	Steep slopes; sediment buildup behind deeply-anchored obstructions (Culling, 1963; Kirkby, 1967).
Cryoturbation	Earth hummocks; mudboils; stone polygons; deformed and discontinuous soil horizons (Lundquist, 1969; Mackay, 1980; Rieger, 1983; Tarnocai and Zoltai, 1978; Zoltai and Tarnocai, 1981).
Flooding	Buried organic matter in soil; stratification of gravel, sand, and silt; location on river flooplain or alluvial terrace (Rieger, 1983).

PROCESS	CHARACTERISTIC FEATURES
Glaciation	Streamlined bedrock forms; glacial erratics, glacial till; morainal topography (Boulton, 1974; Embleton and King, 1975; Gravenor and Kupsch, 1959; Sugden and John, 1976).
Groundwater Discharge	Mineotrophic wetlands; pingos; icings (Carey, 1973; Hamilton and Curtis, 1982; Holmes et al., 1968; Hopkins et al., 1955; Williams, 1970; Zoltai and Tarnocai, 1971, 1975).
Herbivory	Hedging and bark removal of woody plants (moose, hares); disturbance of lichen cover (caribou); clipping of herbs (small mammals) (Anderson and Currier, 1973; Batzli, 1980; Bryant et al., 1992; Helle and Aspi, 1983; Swanson and Barker, 1991; USDI-BLM, 1984).
Ice segregation	Ice laminae; platy soil structure; thermokarst; palsas (Chamberlain, 1981; Rieger, 1983; Williams and Smith, 1989; Zoltai and Tarnocai, 1971, 1975).
Icing	Late-melting ice on floodplains; disturbed vegetation on floodplains; localized braiding of river channels (Alekseyeva. 1987; Carey, 1973; Sloan et al., 1976).
Loess deposition	Silt in a uniform blanket over landscape (Pewe, 1955, 1975).
Plant succession	Regeneration different from current canopy; different vegetation with varying lengths of time since fire (Foote, 1983; Lutz, 1956; Viereck, 1970, 1973; Zasada, 1971).
Riverbank erosion	Steep riverbanks with soil and plants falling into river (Morisawa, 1968).
Rockfall	Talus; scree (Caine, 1974; White, 1981).
Snow avalanches	Avalanche boulder tongues (Luckman, 1977, 1978; Rapp, 1959).

PROCESS	CHARACTERISTIC FEATURES
Soil organic-matter accumulation	Organic soil horizons (Rieger, 1983).
Solifluction, frost creep	Solifluction lobes; sorted and nonsorted steps and stripes; poorly sorted, locally derived deposits on gentle slopes (Benedict, 1970; Pewe, 1975; Washburn, 1956, 1980).
Thermokarsting	Hummocky topography; closed depressions; caving banks of ponds or lakes (Burn, 1992; Czudek and Demek, 1970; Pewe, 1982; Wallace, 1948).
Throughflow	Vertical stiping in vegetation on slopes; organic coloration of runoff; permafrost with shallow active layer and highly permeable organic surface horizons (Haugen et al., 1982; Kane and Hinzman, 1988; Kane et al., 1989; Whipkey and Kirkby, 1978).
Wildfire	Charcoal; fire-scarred trees; even-aged stands of plants which seed or sprout after fire (Lutz, 1956; Pyne, 1984; Rothermal, 1983; Scotter, 1964; Viereck, 1973, 1983; Zasada, 1971).

Definitions of map unit components

Map units were separated subjectively into *major components*. Components were designed to include transect stops with similar landscape setting, soils, and potential vegetation. Between one and six components were defined per map unit, depending on the complexity of the unit. Each transect stop was assigned to a component; the unusual stops that did not fit well into any major component were considered *minor components*. A count of stops for each map unit and component is given in Table 8.

The area occupied by each component in each map unit was estimated from aerial photographs and the field transects. These composition estimates apply to a medium-sized delineation of the map unit (i.e., one of several square kilometers); some components may be absent from smaller delineations. In the case of very large delineations, composition estimates apply to any 10-20 square kilometer area within that delineation.

TABLE 8.--COUNT OF TRANSECT STOPS IN EACH MAP UNIT AND COMPONENT

Map Unit	Transect Stops, by Component							Total
	1	2	3	4	5	6	X*	
Ad	14	20	9	-	-	-	5	48
Ae	10	8	8	2	3	-	2	33
Ah	14	19	5	2	-	-	10	50
Aw	54	18	7	12	4	-	5	100
Ca	45	29	12	6	9	-	3	104
Ck	11	4	6	1	-	-	0	22
Cs	25	9	9	6	-	-	4	53
Fc	10	9	8	-	-	-	5	32
Fr	43	13	5	13	13	-	9	96
Ke	23	22	5	3	6	-	8	67
Ko	16	13	11	5	15	1	4	65
Kw	5	7	3	1	-	-	0	16
Mh	10	0	-	-	-	-	1	11
Ml	8	14	5	11	-	-	3	41
Nu	7	-	-	-	-	-	2	9
Td	21	-	-	-	-	-	3	24
To	6	6	-	-	-	-	2	14
Tw	22	6	3	4	-	-	7	42
All							73	827

*Component "X" includes transect stops that do not fit any of the designated major component; dash indicates no component of that number was established for that manpunit. Approximately 1/4 of all stops have detailed soil descriptions and 1/3 have detailed vegetation descriptions.

Interpretive groups: the soil names and vegetation site types

The *soil names* listed in the Detailed Map Unit Descriptions (Chapter 3) and described further in Chapter 6 refer to interpretive groups of soils created by joining map unit components that contain soils with similar physical properties. All components grouped under a soil name should have similar soil engineering properties, but may differ somewhat in ecologic properties such as potential vegetation.

The *vegetation site types* listed in the Detailed Map Unit Descriptions (Chapter 3) and described further in Chapter 7 are interpretive groups that were created by joining map unit components with similar ecologic conditions for plant growth. The vegetation site types correspond imperfectly to the soils grouped under soil names, because the site types depend mainly on properties of the upper 0.5 m (the rooting zone), while the soil names depend on an approximately 1.5 m-thick layer more significant to engineering.

Data analysis

Soils. Soil properties of each map unit component were summarized with medians and ranges. Ranges were determined by excluding extreme values and reporting the range of those remaining (Swanson, 1993). The highest 10% and lowest 10% were excluded from numerical data (such as depth to frozen soil), while in the case of qualitative data (such as soil texture), approximately 20% of the values judged to be most atypical were excluded.

The median and range for soil properties were calculated separately for each map unit component and for each "Soil Name" interpretive group. Because most of the soil interpretive groups are an amalgamation of data from several map unit components, the medians and ranges for a group will not match exactly the medians and ranges for any components that it includes. Where the component sample is small and contains outliers, the 10-to-90th percentile range for a component may extend slightly outside of the 10-to-90th percentile range for the interpretive group to which it belongs. Also, note that the detailed soil horizon data summarized in Chapter 6 was collected only at intensive transect stops, while the soil information in the map unit descriptions was summarized from the larger data set of all transect stops.

In a few cases, the sample size for a map unit component was insufficient for data analysis. To compensate, several similar components in different map units were joined together, and the resulting summary was repeated in each individual component description (Chapter 3). Specifically, all small stream flood plains on moraines (components Ae4, Ah4, Aw5, Ke5, and Ko6) were joined together for data analysis, and the summary was repeated under each component. Likewise, small stream flood plains on the glaciated bedrock hills (Ca5 and Ck4) were joined for data analysis.

The depths to frozen soil reported in the map unit descriptions are depths to frozen soil during July and August of 1992 and 1993. The depth to permafrost is somewhat greater. Also, frozen soil is reported to be absent in this report if no frozen material was encountered in hand auger borings. Permafrost could in fact be present at depths greater than sampled here (1.5 m, or shallower in the case of rocky soils).

Vegetation. The *vegetation structure* summaries in the Detailed Map Unit Descriptions (Chapter 3) and Vegetation Site Type Descriptions (Chapter 7) were made using data from all the transect stops by excluding 20% of the atypical observations as described earlier for soils. If a stratum is sometimes absent from the stand, it is indicated in parentheses. The *major species* listed for each map unit component (Chapter 3) were made by selecting the most abundant plants in each stratum from the species summary tables for the vegetation site types in Chapter 7, discussed below.

The species *constancy* values in Chapter 7 are the percentage of intensive transect stops at which a certain plant taxon was observed. *Mean cover* for each plant taxon was calculated using only the sample stops where that taxon occurred; this convention was chosen to better portray plants with a patchy distrubiton (i.e. are locally abundant). Means were calculated from the cover class data by using midpoints of the cover classes (e.g., 15% for the 5-25% cover class). Because the total moss and lichen covers were classified separately from the individual species, the average species covers do not add up exactly to the average total covers.

Compilation of land use and management information

The USDA texture, Unified and AASHTO textural classifications, and percent coarse fragments, and pH are all based on field estimates. Soil pH measurements were made with color indicators in the field. Permeability, available water capacity, shrink/swell potential, potential for frost action, and risk of corrosion were estimated from the field data using standard NRCS guidelines.

Suitability ratings for most land uses were made using standard NRCS guidelines, with some modifications for subarctic conditions (Appendix II). Ratings for wildlife habitat suitability were made using criteria developed for this study; see the Wildlife Habitat Value section of Chapter 5 for details. The suitabilities of the map units for a transportation corridor (Chapter 5) were assessed using criteria in Environment Canada (1976), Johnston (1981), McFadden and Bennett (1991), McRoberts and Morgenstern (1974), U.S. Army (1966), and personal communication with Alaska Department of Transportation engineers.

Chapter 3: Map Unit Descriptions

Physiographic Map Unit Descriptions

(see Plate 1)

A. *Ambler Moraines*

(Detailed map units Ad, Ae, Ah, Aw)

Landforms: Undulating to very hilly moraines of Ambler age (age intermediate between Walker Lake and Kobuk moraines). Morainal topography still apparent. Local relief generally less than 60 m (200 feet), locally to 150 m (500 feet) where dissected by the Kobuk River. Slopes 0-40%.

Geologic materials: Glacial till covered by more than 0.5 m of loess or colluviated loess in most areas.

Soils: Mostly wet, silty soils with permafrost (locally drier with a thick active layer in burned areas). Organic soils in depressions. Dry, shallow, gravelly soils on hilltops. (Cryaquepts - Cryochrepts, cool - Cryochrepts, shallow)

CM. *Colluvial Slopes and Mountains*

(Detailed map units Ca, Ck, Cs, Mh, Ml)

Landforms: Bedrock-cored hills with colluvial slopes and rocky summits. Lower-elevation portions of this unit have been glaciated in some areas. Local relief generally more than 150 m (500 feet). Slopes mostly 0-70%

Geologic materials: Bedrock outcrops, weathered bedrock, loess, glacial till, and colluvium.

Soils: Wet, loamy soils with permafrost on concave slopes (locally drier and with thick active layer in burned areas). Dry, shallow, gravelly soils on upper slopes and crests. (Cryaquepts, loamy substratum - Cryochrepts, cool - Cryochrpets, bedrock substratum.)

FT. *Flood Plains and Terraces*

(Detailed map units Fc, Fr, Td, To, Tw)

Landforms: Nearly level alluvial plains. Local relief up to 15 m (50 feet) on terrace escarpments.

Geologic materials: Stratified silty and sandy alluvium or silty loess over sand and gravel. Fine-grained surface material thin or absent on some surfaces.

Soils: Dry soils with thin loamy surface over sand and gravel on frequently to occasionally flooded areas near major rivers, and on some unflooded terraces. Wet, loamy soils with permafrost on most rarely flooded and unflooded areas (locally drier with a thick active layer in burned areas). (Cryofluvents - Cryochrepts, shallow - Pergelic Cryaquepts.)

K. *Kobuk Moraines*

(Detailed map units Ke, Ko, Kw)

Landforms: Rolling moraine of Kobuk age (oldest in the study area). Morainal topography obliterated by erosion; surfaces now dissected by streams. Local relief generally less than 150 m (500 feet).

Geologic materials: Glacial till and outwash covered by more than 1 m of loess and colluviated loess.

Soils: Mostly silty, wet soils with permafrost (locally drier with a thick active layer in burned areas). Dry, deep, silty soils without permafrost on hilltops. (Cryaquepts - Cryochrepts, cool - Cryochrepts, silty.)

N. *Nutuvukti Moraines*

(Detailed map unit Nu)

Landforms: Very hilly moraine of Walker Lake age (youngest in the study area). Morainal topography fresh. Local relief generally less than 30 m (100 feet). Slopes short and steep, 0-35%.

Geologic materials: Coarse-grained glacial till (sand, gravel, cobbles, and boulders).

Soils: Dry, shallow, gravelly soils throughout, except in depression bottoms. (Cryochrepts, shallow.)

Detailed Map Unit and Component Legend

Ad ***Ambler moraines, dissected***
1 Moist slopes and summits with post-burn thaw
2 Dry crests and slopes
3 Lower slopes with permafrost

Ae ***Ambler moraines, ecotonal (lowland tundra-forest)***
1 Tussock tundra
2 Gentle slopes (forested)
3 Dry knobs
4 Small stream flood plains
5 Wet depressions with peat mounds

Ah ***Ambler moraines, hilly***
1 Wet slopes with permafrost
2 Dry crests and slopes
3 Moist slopes with post-burn thaw
4 Small stream flood plains

Aw ***Ambler moraines, wet***
1 Gentle slopes with permafrost
2 Dry knobs
3 Peat plateaus
4 Thermokarst depressions
5 Small stream flood plains

Ca ***Colluvium and Ambler till on bedrock-cored hills***
1 Wet lower- to mid-slopes
2 Dry crests and upper slopes
3 Moist upper slopes and crests with post-burn thaw
4 Wet upper slopes and crests with permafrost
5 Small stream flood plains

Ck ***Colluvium and Kobuk till on bedrock-cored hills***
1 Wet lower- to mid-slopes
2 Moist upper slopes and summits with post-burn thaw
3 Dry crests and upper slopes
4 Small stream flood plains

Cs ***Colluvial slopes***
1 Striped colluvial slopes
2 Small stream flood plains
3 Gravelly slopes
4 Alluvial fans

Fc ***Creek flood plains***
1 Moist flood plain with permafrost
2 Unfrozen wet areas and depressions
3 Dry flood plain

Fr ***River flood plains***
1 Rarely flooded areas with permafrost
2 Dry, occasionally flooded areas (tall scrub and poplar forest)
3 Gravel bars, frequently flooded
4 Dry, occasionally flooded areas (white spruce/alder forest)
5 Wet depressions and channels

Ke ***Kobuk moraines, ecotonal (lowland tundra-forest)***
1 Mudboil tundra
2 Dry crests and upper slopes
3 Tussock tundra
4 Thermokarsting low areas
5 Small stream flood plains

Ko ***Kobuk moraines***
1 Gentle slopes with permafrost
2 Striped colluvial slopes with permafrost
3 Dry crests and upper slopes
4 Gentle slopes with post-burn thaw
5 Wet, nearly level areas with peat
6 Small stream flood plains

Kw ***Kobuk moraines, wet***
1 Gentle slopes (tussocks)
2 Gentle to moderate slopes (forest)
3 Dry knobs
4 Thermokarst depressions

Mh ***High Mountains***
1 Steep slopes with rubbly soils
2 Rock outcrops

Ml ***Low Mountains***
1 Dry crests and upper slopes (forest and scrub)
2 Midslopes, unfrozen (forest)
3 Dry crests and upper slopes (tundra)
4 Steep north slopes with permafrost

Nu ***Nutuvukti moraines***
1 Dry crests and slopes

Td ***Dry river terraces***
1 Level areas with shallow soils over gravel

To ***Older river terraces***
1 Areas of moist soils with post-burn thaw
2 Areas of wet soils with permafrost

Tw ***Wet river terraces***
1 Frozen terraces, mesotrophic
2 Thermokarst pits and ribbed fens
3 Frozen terraces, minerotrophic
4 Palsas and peat plateaus

Detailed Map Unit Descriptions

Ad = Ambler Moraines, Dissected

(Nat.'l Coop Soil Survey name: Cryaquepts, cool - Cryochrepts, shallow - Cryaquepts association, very hilly)

Map unit setting: lowlands in the vicinity of Lower Kobuk Canyon, where the Kobuk River and its tributary streams have incised (Fig. 3). These moraines are intermediate in age between the Kobuk and Nutuvukti moraines. Incision of streams has left most of the moraine surface as a well-drained plateau. Elevation: 152 to 290 m (500 to 950 feet) above sea level.

Component 1: Moist slopes and summits with post-burn thaw

Setting

Area covered by component: 10 to 60% of map unit
Position on the landscape: gentle crests and slopes of glacial moraines, usually in areas burned within the past 100 years
Geologic material: loess over glacial outwash or colluvium
Slope shape: concave to plane
Slope steepness: 0 to 20%

Soil

Soil name: Cryochrepts, cool (Chapter 6)
Soil profile:

Organic matter

Silt loam or loam; or
gravelly silt loam, loam, or sandy loam

Very gravelly sandy loam or loam; or
extremely gravelly loamy sand or sand

Thickness of the organic mat: median 7 cm (range 2 to 14 cm)
Water table (Jul-Aug): none, but part of the upper 50 cm of soil is occasionally saturated
Depth to very or extremely gravelly material: median 75 cm (range 40 to 125 cm) from the mineral soil surface
Redoximorphic features: low-chroma mottles throughout the profile of most soils; low-chroma matrix occasionally also present in part of the profile

Vegetation

Structure: needleleaf open forest or woodland/open tall scrub/low scrub/moss and lichens; () = stratum may be absent, / = "over"
Major species: *Picea mariana, Betula glandulosa, Ledum palustre, Vaccinium uliginosum, Polytrichum spp., Cladonia spp.*

Vegetation site type: Burn thaw-susceptible terraces and uplands (Chapter 7)

Major Landscape-Forming Processes

Biochemical reduction - temporarily less active due to lowering of permafrost table after fire
Cryoturbation and ice segregation - temporarily less active due to lowering of permafrost table; has produced fragmented soil horizons and earth hummocks
Herbivory - moose browsing
Soil organic-matter accumulation
Plant succession (Chapter 7)
Wildfire - black spruce forest (where present) carries fire well; deciduous post-fire regeneration is less flammable.

Component 2: Dry crests and slopes

Setting

Area covered by component: 20 to 50% of map unit
Position on the landscape: crests and upper slopes of glacial moraines
Geologic material: loess over glacial outwash or colluvium
Slope shape: convex to plane
Slope steepness: 0 to 40%

Soil

Soil name: Cryochrepts, shallow (Chapter 6)
Soil profile:

Organic matter

Silt loam, loam or sandy loam; or
gravelly silt loam, loam, or sandy loam

Sand and gravel

Thickness of the organic mat: median 3 cm (range 0 to 12 cm)
Water table (Jul-Aug): none within 150 cm of the surface
Depth to sand and gravel: median 45 cm range (range 25 to 75 cm) from the mineral soil surface
Redoximorphic features: low-chroma mottles occasionally present in the upper 0.5 m

Vegetation

Structure: needleleaf, broadleaf, or mixed open forest or woodland/(open tall scrub)/low scrub/lichens and moss; () = stratum may be absent, / = "over"
Major species: *Picea mariana, Populus tremuloides, Betula glandulosa, Ledum palustre, Vaccinium uliginosum, Cladina spp., Polytrichum spp.*
Vegetation site type: Dry terraces and uplands (lichen woodland)(Chapter 7)

Major Landscape-Forming Processes

Biochemical reduction - occurs but weak due to dryness
Herbivory - caribou graze lichens (where unburned); moose browse

Soil organic-matter accumulation - occurs but is limited by dryness
Plant succession (Chapter 7)
Wildfire - black spruce forest (where present) carries fire well; deciduous post-fire regeneration is less flammable.

Component 3: Lower slopes with permafrost

Setting

Area covered by component: 10 to 40% of map unit
Position on the landscape: midslopes and lower slopes of glacial moraines
Geologic material: organic matter over loess or colluvium
Slope shape: concave to plane
Slope steepness: 0 to 10%

Soil

Soil name: Cryaquepts (Chapter 6)
Soil profile:

Organic matter

Silt loam or loam

Permanently frozen silt loam or loam

Thickness of the organic mat: median 25 cm (range 15 to 45 cm)
Water table (Jul-Aug): occasionally present near the mineral soil surface, and the thawed mineral soil is usually saturated.
Depth to frozen soil (Jul-Aug): median 53 cm (range 30 to 78 cm)
Redoximorphic features: low-chroma matrix present throughout the mineral soil

Vegetation

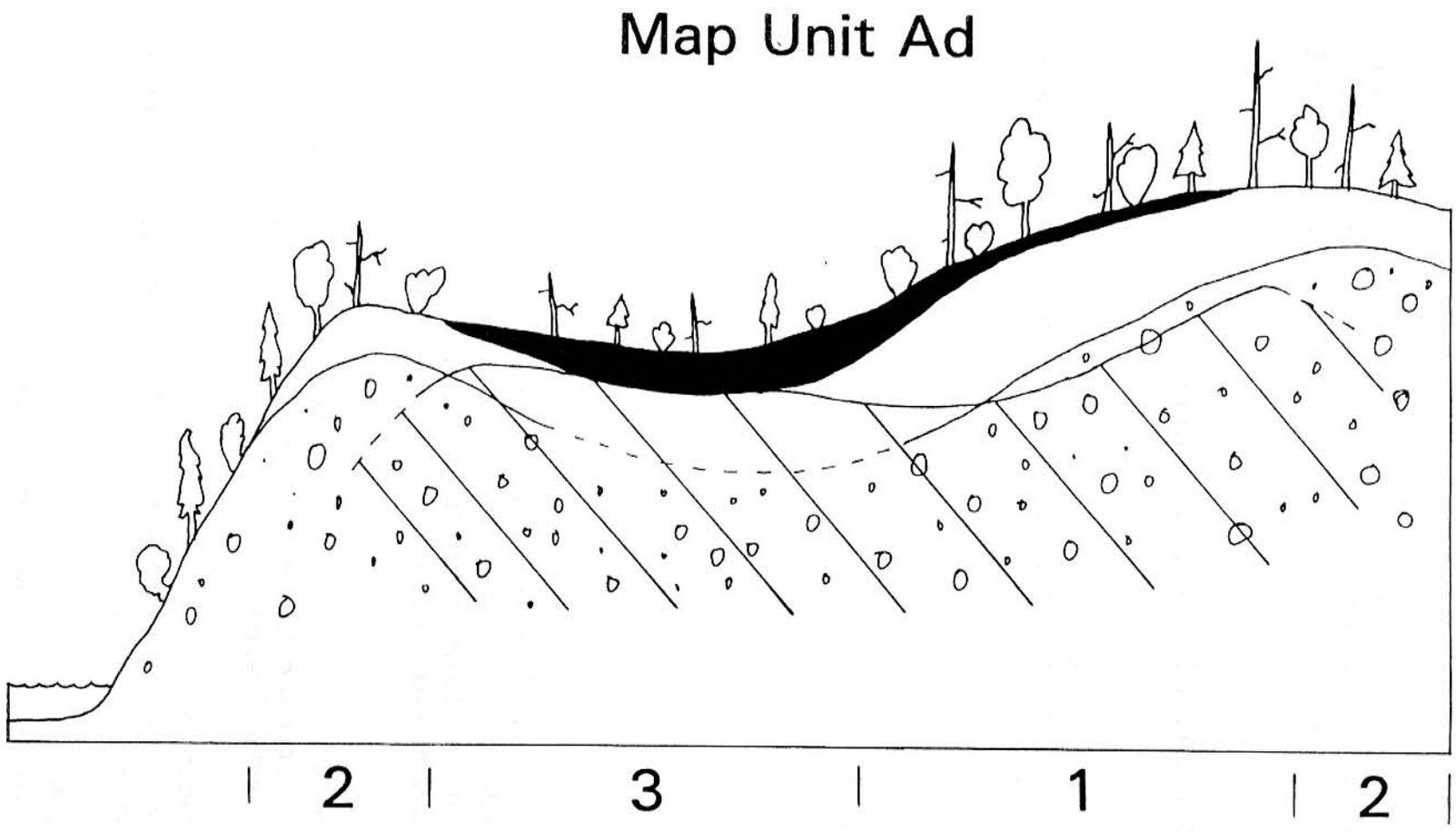
Structure: needleleaf open forest or woodland/closed low scrub/graminoids/moss; () = stratum may be absent, / = "over"
Major species: *Picea mariana, Ledum palustre, Vaccinium uliginosum, Carex spp., Sphagnum spp.*
Vegetation site type: Frozen moraines and terraces, forested (Chapter 7)

Major Landscape-Forming Processes

Biochemical reduction
Cryoturbation and ice segregation - has produced mudboils, fragmented soil horizons, and earth hummocks
Herbivory - microtine sign
Soil organic-matter accumulation
Plant succession (Chapter 7)
Wildfire - black spruce forest carries fire well. Wet lower organic horizon on some of this component probably survives fires. After severe fires, some better-drained portions of this component may convert to component 1.

Minor Components

*Fragments of river terraces
*Moist depressions without permafrost
*Escarpments with 40 to 90% slopes
*Flood plains of small streams



Ad ***Ambler moraines, dissected***

1 Moist slopes and summits with post-burn thaw
2 Dry crests and slopes
3 Lower slopes with permafrost

Fig. 3. Landscape diagram of map unit Ad.

Ae = Ambler Moraines, Ecotonal (lowland tundra-forest)

(Nat.'l Coop Soil Survey name: Cryaquepts - Cryochrepts, shallow association, hilly)

Map unit setting: lowlands south of Selby Lake (Fig 4). These moraines are intermediate in age between Kobuk and Nutuvukti moraines and still retain some morainal topography. Loess is more than 0.5 m thick over most of the moraine. Elevation: 137 to 274 m (450 to 900 feet) above sea level.

Component 1: Tussock tundra

Setting

Area covered by component: 50 to 65% of map unit
Position on the landscape: gentle slopes and broad, nearly level crests of glacial moraines
Geologic material: organic matter over loess
Slope shape: plane to convex
Slope steepness: 0 to 5%

Soil

Soil name: Cryaquepts (Chapter 6)
Soil profile:

Organic matter

Silt loam or loam

Permanently frozen silt loam or loam

Thickness of the organic mat: median 27 cm (range 12 to 40 cm)
Water table (Jul-Aug): median depth to the water table 20 cm (range 15 to 25 cm)
Depth to frozen soil (Jul-Aug): median 30 cm (range 25 to 38 cm)
Redoximorphic features: low-chroma matrix throughout the mineral soil

Vegetation

Structure: closed low scrub/graminoids/moss; () = stratum may be absent, / = "over"
Major species: *Ledum palustre, Vaccinium spp., Eriophorum vaginatum, Sphagnum spp.*
Vegetation site type: Tussock tundra (Chapter 7)

Major Landscape-Forming Processes

Abrasion of plants by windblown snow - kills spruce foliage 0.5-1.5 m above the ground surface; hinders or prevents growth of trees
Biochemical reduction
Cryoturbation and ice segregation
Herbivory - caribou probably graze sedges; microtine sign present
Soil organic-matter accumulation - produces tussocks
Thermokarst - potential if surface is disturbed
Throughflow - through organic surface layer

Wildfire - spreads readily in dry graminoids; moist lower portion of the organic mat usually survives fires

Component 2: Gentle slopes (forested)

Setting

Area covered by component: 15 to 20% of map unit
Position on the landscape: slopes of glacial moraines
Geologic material: organic matter over colluvium from loess and glacial till
Slope shape: plane to concave
Slope steepness: 0 to 12%

Soil

Soil name: Cryaquepts (Chapter 6)
Soil profile:

Organic matter

Silt loam, loam, sandy loam,
gravelly loam, very gravelly loam

Permanently frozen:
Silt loam, loam, sandy loam,
gravelly loam, very gravelly loam

Thickness of the organic mat: median 27 cm (range 12 to 44 cm)
Water table (Jul-Aug): Occasionally present near the mineral soil surface, and the thawed mineral soil is usually saturated
Depth to frozen soil (Jul-Aug): median 27 cm (range 24 to 68 cm); locally deeper in burned areas
Redoximorphic features: low-chroma matrix throughout the mineral soil

Vegetation

Structure: needleleaf open forest or woodland/closed low scrub/(graminoids)/moss; () = stratum may be absent, / = "over"
Major species: *Picea mariana, Ledum palustre, Vaccinium uliginosum, Carex spp., Sphagnum spp.*
Vegetation site type: Frozen moraines and terraces, forested (Chapter 7)

Major Landscape-Forming Processes

Biochemical reduction
Cryoturbation and ice segregation
Soil organic-matter accumulation
Plant succession (Chapter 7)
Thermokarst - potential if surface is disturbed
Throughflow - through surface organic mat
Wildfire - spreads readily in black spruce forest. Moist lower portion of the organic mat usually survives fires.

Component 3: Dry knobs

Setting

Area covered by component: 10 to 20% of map unit
Position on the landscape: upper slopes and crests of glacial moraines
Geologic material: glacial till or outwash
Slope shape: convex to plane
Slope steepness: 0 to 35%

Soil

Soil name: Cryochrepts, shallow (Chapter 6)
Soil profile:

Organic matter

Gravelly loam, very
gravelly sandy loam

Extremely gravelly loamy
sand or sand

Thickness of the organic mat: median 2 cm (range 2 to 5 cm)
Water table (Jul-Aug): none within 150 cm of the surface
Depth to very or extremely gravelly material: median 0 cm (range 0 to 25 cm) from the mineral soil surface
Redoximorphic features: none

Vegetation

Structure: mixed or deciduous forest or woodland/open low scrub/(lichens); () = stratum may be absent, / = "over"
Major species: *Picea mariana, Populus tremuloides, Ledum palustre, Vaccinium uliginosum, Cladina spp.*
Vegetation site type: Dry terraces and uplands (lichen woodland)(Chapter 7)

Major Landscape-Forming Processes

Biochemical reduction - occurs but weak due to good drainage
Herbivory - moose browsing
Soil organic-matter accumulation - occurs but hindered by dryness
Plant succession (Chapter 7)
Wildfire - spreads readily black spruce forest with lichens. Post-burn vegetation is less flammable. Dry organic layer can be nearly consumed by severe fires.

Component 4: Small stream flood plains

Setting

Area covered by component: 3 to 5% of map unit
Position on the landscape: channels on glacial moraines

Geologic material: alluvium
Slope shape: concave
Slope steepness: 0 to 5%

Soil

Soil profile:

Organic matter

Silt loam, or stratified
silt and sand

Very to extremely gravelly
loam, loamy sand, or sand

Thickness of the organic mat: median 6 cm (range 0 to 15 cm)
Water table (Jul-Aug): occasionally present within 50 cm of the surface, and the soil is usually saturated within 50 cm the surface.
Depth to sand and gravel: median more than 50 cm (range 15 to more than 50 cm) from the mineral soil surface
Redoximorphic features: low-chroma matrix in mineral soil

Vegetation

Structure: (tall scrub)/closed low scrub/(graminoids)/moss; () = stratum may be absent, / = "over"
Major species: *Salix spp., Vaccinium uliginosum, Calamagrostis canadensis, Drepanocladus spp., Sphagnum spp.*
Vegetation site type: Small stream flood plains on moraines (Chapter 7)

Major Landscape-Forming Processes

Biochemical reduction
Flooding and alluviation - frequent; prevents buildup of thick organic surface layer
Herbivory - moose browse willows
Icing - likely if natural drainage is blocked
Soil organic-matter accumulation
Throughflow

Component 5: Depressions with peat mounds

Setting

Area covered by component: 1 to 5% of map unit
Position on the landscape: depressions on glacial moraines
Geologic material: organic matter over loess
Slope shape: concave
Slope steepness: 0 to 2%

Soil

Soil name: Histosols (Chapter 6)

Soil profile:

Organic matter

Permanently frozen
organic matter

Permanently frozen
silt loam

Thickness of the organic mat: 30 cm or more
Water table (July-Aug): none on the mounds, but at the surface in the hollows
Depth to frozen soil (Jul-Aug): median 35 cm (range 30 to 40 cm)
Redoximorphic features: low-chroma matrix in the mineral soil

Vegetation

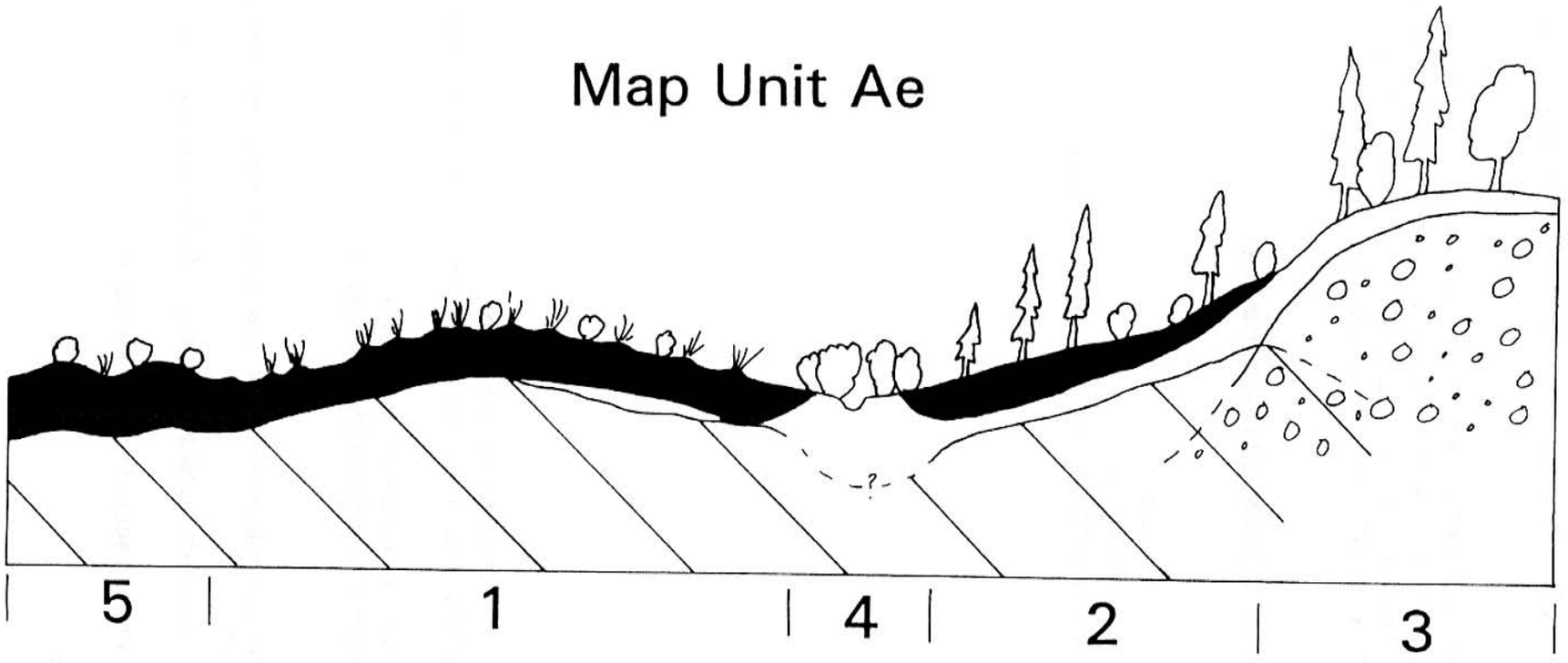
Structure: closed low scrub/graminoids/mosses and lichens; ()=stratum may be absent, /="over"
Major species: *Ledum palustre, Vaccinium spp., Eriophorum spp., Sphagnum spp., Cladina spp.*
Vegetation site type: Pit and mound depressions, tundra (Chapter 7)

Major Landscape-Forming Processes

Biochemical reduction
Cryoturbation and ice segregation - produces peat mounds
Herbivory - caribou graze lichens; microtine sign present
Soil organic-matter accumulation
Plant succession (Chapter 7)
Thermokarst - produces 0.5 to 1 m of subsidence
Wildfire - spreads readily in dry lichens. Moist lower portion of the organic mat may survive fire

Minor Components

*Wet, peat-filled, thermokarst pits in component 5
*Moist depressions without permafrost or peat
*Slopes steeper than 35%



Ae ***Ambler moraines, ecotonal (lowland tundra-forest)***

1 Tussock tundra
2 Gentle slopes (forested)
3 Dry knobs
4 Small stream floodplains
5 Wet depressions with peat mounds

Fig. 4. Landscape diagram of map unit Ae

Ah = Ambler Moraines, hilly

(Nat.'l Coop Soil Survey name: Cryaquepts - Cryochrepts, shallow - Cryochrepts, cool association, very hilly)

Map unit setting: lowlands in the eastern and central parts of the study area (Fig. 5). These moraines are intermediate in age between Kobuk and Nutuvukti moraines and still retain some original moraine topography. Loess is at least 0.5 m thick over most of the map unit. Elevation: 122 to 457 m (400 to 1500 feet) above sea level.

Component 1: Wet slopes with permafrost

Setting

Area covered by component: 5 to 75% of map unit
Position on the landscape: slopes of glacial moraines
Geologic material: organic matter over colluviated loess and glacial till or outwash
Slope shape: plane to concave
Slope steepness: 2 to 18%

Soil

Soil name: Cryaquepts (Chapter 6)
Soil profile:

Organic matter

Silt loam, loam, or sandy loam; or
gravelly silt loam, loam, or
sandy loam

Permanently frozen: silt loam, loam,
or sandy loam; or gravelly silt loam,
loam, or sandy loam

Thickness of the organic mat: median 21 cm (range 14 to 50 cm)
Water table (Jul-Aug): occasionally present near the mineral soil surface, and the thawed mineral soil is often saturated
Depth to frozen soil (Jul-Aug): median 45 cm (range 26 to 65 cm)
Redoximorphic features: low-chroma matrix throughout the mineral soil

Vegetation

Structure: needleleaf open forest or woodland/open tall or low scrub/graminoids/moss; () = stratum may be absent, / = "over"
Major species: *Picea mariana, Betula glandulosa, Ledum palustre, Vaccinium uliginosum, Carex spp., Sphagnum spp.*
Vegetation site type: Frozen moraines and terraces, forested (Chapter 7)

Major Landscape-Forming Processes

Biochemical reduction

Herbivory - microtine sign common
Ice segregation and cryoturbation
Soil organic-matter accumulation
Succession (Chapter 7)
Throughflow - mainly in the organic mat
Wildfire - spreads readily in black spruce forest; moist lower portion of the organic mat may survive fire or may burn deeply to produce component 3

Component 2: Dry Crests and slopes

Setting

Area covered by component: 20 to 40% of map unit
Position on the landscape: crests and slopes of glacial moraines
Geologic material: loess over glacial outwash or glacial till
Slope shape: convex
Slope steepness: 0 to 30%

Soil

Soil name: Cryochrepts, shallow (Chapter 6)
Soil profile:

Organic matter

Silt loam; loam, sandy loam; or
Gravelly silt loam, loam, or sandy loam

Very or extremely gravelly sand, sandy loam, or fine sand

Thickness of the organic mat: median 3 cm (range 0 to 10 cm)
Water table (Jul-Aug): none within 150 cm of the surface
Depth to sand and gravel: median 40 cm (range 0 to 75 cm) from the mineral soil surface
Redoximorphic features: low-chroma mottles rare in the loamy surface soil

Vegetation

Structure: needleleaf, broadleaf, or mixed open forest or woodland/low scrub/lichens; () = stratum may be absent, / = "over"
Major species: *Picea mariana, Populus tremuloides, Ledum palustre, Vaccinium uliginosum, Cladina spp.*
Vegetation site type: Dry terraces and uplands (lichen woodland)(Chapter 7)

Major Landscape-Forming Processes

Herbivory - lichens grazed by caribou; aspen and birch trees browsed by caribou or moose
Soil organic-matter accumulation - occurs but limited by dryness
Podzolization - occurs locally in sandy areas
Succession (Chapter 7)
Wildfire - spreads readily in black spruce forest; organic mat consumed almost entirely by severe fires

Component 3: Moist slopes with post-burn thaw

Setting

Area covered by component: 0 to 60% of map unit
Position on the landscape: moraine slopes, usually in areas burned within the past 100 years
Geologic material: loess over glacial till
Slope shape: plane to concave
Slope steepness: 0 to 8%

Soil

Soil name: Cryochrepts, cool (Chapter 6)
Soil profile:

Organic matter

Silt loam or loam; or
gravelly sandy loam

Sand and gravel

Thickness of the organic mat: median 6 cm (range 5 to 25 cm)
Depth to sand and gravel: median more than 150 cm (range 60 to more than 150 cm) from the mineral soil surface
Water table (Jul-Aug): none within 150 cm of the surface
Redoximorphic features: low-chroma mottles usually present in the upper loamy material; low-chroma matrix usually present in irregular patches or below 1 m depth

Vegetation

Structure: open needleleaf forest/open tall scrub/closed low scrub/moss and lichens; () = stratum may be absent, / = "over"
Major species: *Picea mariana, Betula glandulosa, Vaccinium uliginosum, Ledum plaustre, Polytrichum spp., Cladonia spp.*
Vegetation site type: Burn thaw-susceptible terraces and uplands (Chapter 7)

Major Landscape-Forming Processes

Biochemical reduction - temporarily weak due to lowered permafrost table
Ice segregation and cryoturbation - temporarily less active due to lowered permafrost table
Soil organic-matter accumulation
Throughflow - mainly through the organic mat
Wildfire - temporarily less flammable until fuels recover; component forms by severe burn of component 1

Component 4: Small stream flood plains

Setting

Area covered by component: 5 to 10% of map unit
Position on the landscape: drainage channels on glacial moraines

Geologic material: alluvium
Slope shape: concave
Slope steepness: 1 to 10%

Soil
Soil profile:

Organic matter

Silt loam or stratified
sand and silt

Very or extremely gravelly
loam, sandy loam, or sand

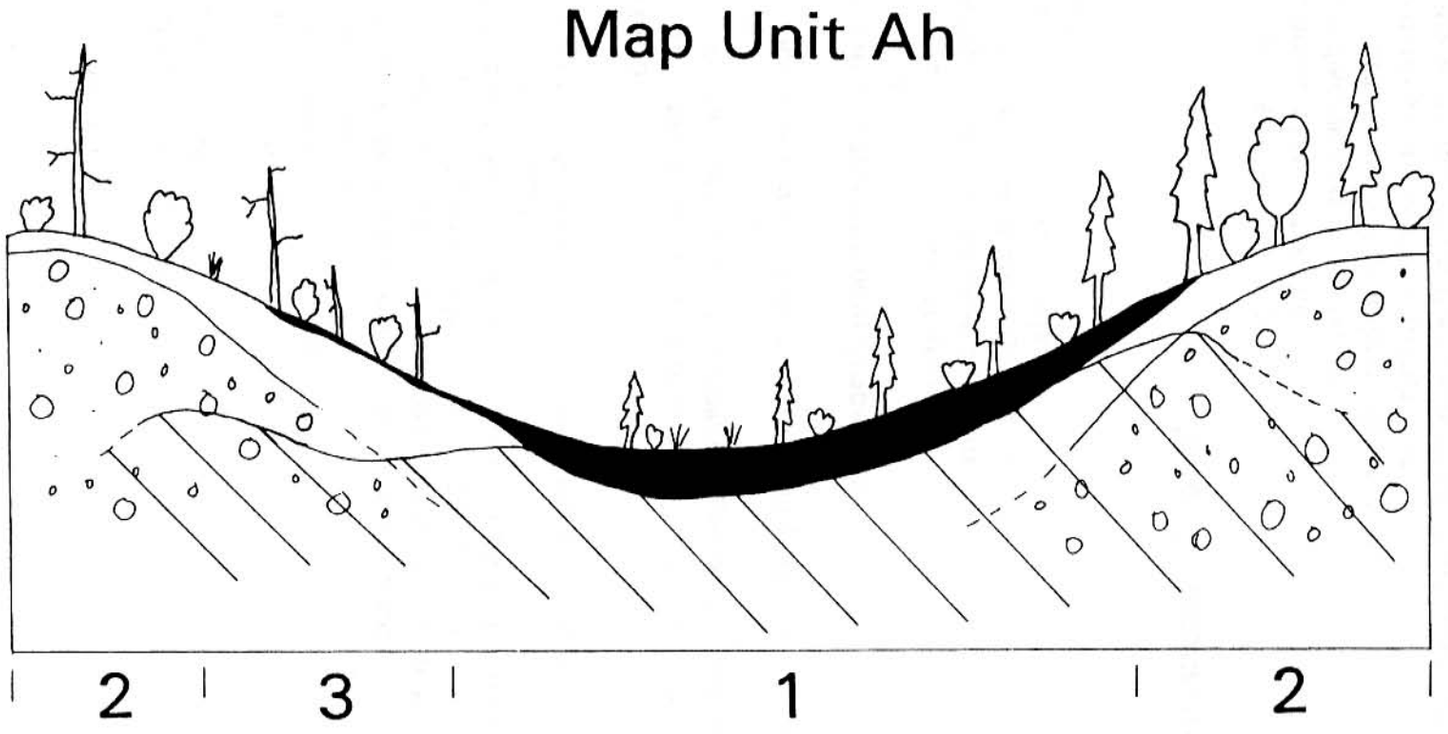
Thickness of the organic mat: median 6 cm (range 0 to 15 cm)
Water table (Jul-Aug): occasionally present within 50 cm of the surface, and the soil is usually saturated within 50 cm of the surface
Depth to sand and gravel: median more than 50 cm (range 15 to more than 50 cm) from the mineral soil surface
Redoximorphic features: low-chroma matrix throughout the profile

Vegetation
Structure: (tall scrub)/low scrub/graminoids/moss; () = stratum may be absent, / = "over"
Major species: *Salix spp., Vaccinium uliginosum, Calamagrostis canadensis, Drepanocladus spp.*
Vegetation site type: Small stream flood plains on moraines (Chapter 7)

Major Landscape-Forming Processes
Biochemical reduction
Flooding and alluviation - frequent
Herbivory - willows browsed by moose
Icing - likely if natural drainage is blocked
Soil organic-matter accumulation
Throughflow

Minor Components

*Flood plains of small streams
*Fragments of river terraces
*Seeps discharging groundwater
*Peat plateaus with thermokarst depressions
*Wet depressions without permafrost
*Escarpments bordering the Kobuk River flood plain with slopes up to 60%



Ah ***Ambler moraines, hilly***

1 Wet slopes with permafrost
2 Dry crests and slopes
3 Moist slopes with post-burn thaw
4 Small stream floodplains

Fig. 5. Landscape diagram of map unit Ah

Aw = Ambler Moraines, Wet

(Nat.'l Coop Soil Survey name: Cryaquepts - Cryochrepts, shallow - Histosols association, undulating)

Map unit setting: lowlands with gentle topography in the eastern and central parts of the study area (Fig. 6). These moraines are intermediate in age between the Kobuk and Nutuvukti moraines. Loess is at least 0.5 m thick over most of the moraine. Elevation: 137 to 366 m (450 to 1200 feet) above sea level

Component 1: Gentle slopes with permafrost

Setting

Area covered by component: 40 to 80% of map unit
Position on the landscape: gentle crests and slopes of glacial moraines
Geologic material: organic matter over loess or colluviated loess
Slope shape: concave, plane, or convex
Slope steepness: 0 to 8%

Soil

Soil name: Cryaquepts (Chapter 6)
Soil profile:

Organic matter

Silt loam

Permanently frozen
silt loam

Thickness of the organic mat: median 28 cm (range 15 to 50 cm)
Water table (Jul-Aug): occasionally present near the mineral soil surface, and the thawed mineral soil is usually saturated
Depth to frozen soil (Jul-Aug): median 48 cm (range 29 to 65 cm) from the mineral soil surface
Redoximorphic features: low-chroma matrix throughout the profile

Vegetation

Structure: (needleleaf open forest, woodland, or dwarf tree scrub)/low scrub/graminoids/moss; () = stratum may be absent, / = "over"
Major species: *Picea mariana, Betula glandulosa, Ledum palustre, Vaccinium uliginosum, Eriophorum vaginatum, Sphagnum spp.*
Vegetation site type: mainly Tussock wetland; also Frozen moraines and terraces, forested (Chapter 7)

Major Landscape-Forming Processes

Cryoturbation and ice segregation - has produced earth hummocks and frost-churned soil; has raised the surface on parts of this component, allowing thermokarst to occur

Groundwater discharge - occurs locally in seeps
Herbivory - microtine sign common; microtine clipping of *Eriophorum*
Soil organic-matter accumulation - has produced tussocks and moss hummocks
Plant succession (Chapter 7)
Thermokarst - has resulted in 1 to 2 m of subsidence; produces component 4 from this component
Throughflow - mainly through the organic mat
Wildfire - fires carry well across black spruce forest and graminoids of this unit; the moist lower portion of the organic mat usually survives fires

Component 2: Dry knobs

Setting

Area covered by component: 5 to 20% of map unit
Position on the landscape: crest and slopes of glacial moraines
Geologic material: loess over glacial outwash or till
Slope shape: convex or plane
Slope steepness: 0 to 8%

Soil

Soil name: Cryochrepts, shallow (Chapter 6)
Soil profile:

Organic matter

Silt loam, loam or sandy loam; or
gravelly silt loam, loam, or sandy loam

Sand and gravel

Thickness of the organic mat: median 2 cm (range 0 to 8 cm)
Water table (Jul-Aug): none within 150 cm of the surface
Depth to sand and gravel: median 40 cm (range 0 to 75 cm) from the mineral soil surface
Redoximorphic features: low-chroma mottles occasionally present in loamy material

Vegetation

Structure: open needleleaf forest or woodland/tall or low scrub/lichens; () = stratum may be absent, / = "over"
Major species: *Picea mariana, Betula glandulosa, Ledum palustre, Vaccinium uliginosum, Cladina spp.*
Vegetation site type: Dry terraces and uplands (lichen woodland)(Chapter 7)

Major Landscape-Forming Processes

Herbivory - caribou graze lichens; aspen, shrub birch, and willows browsed by caribou or possibly moose
Soil organic-matter accumulation - occurs but limited by dryness
Plant succession (Chapter 7)
Wildfire - fires carry well across black spruce forest; the thin, often dry organic mat is likely

to be consumed almost entirely by most fires

Component 3: Peat plateaus

Setting

Area covered by component: 0 to 40% of map unit
Position on the landscape: level low portions of glacial moraines
Geologic material: organic matter
Slope shape: plane
Slope steepness: 0 to 1%

Soil

Soil name: Histosols (Chapter 6)
Soil profile:

Slightly decomposed
organic matter

Moderately to highly decomposed
organic matter

Permanently frozen: moderately to
highly decomposed organic matter

Thickness of the organic mat: more than 35 cm
Depth to moderately or highly decomposed organic matter: 10 to 30 cm from the surface
Water table (Jul-Aug): none; soil is occasionally saturated in the lower half of the thawed layer
Depth to frozen soil (Jul-Aug): median 30 cm (range 28 to 35 cm)

Vegetation

Structure: needleleaf open forest, woodland, or dwarf tree scrub/closed low scrub/lichens; () = stratum may be absent, / = "over"
Major species: *Picea mariana, Betula glandulosa, Ledum palustre, Vaccinium uliginosum, Cladina spp.*
Vegetation site type: Peat plateaus (Chapter 7)

Major Landscape-Forming Processes

Cryoturbation and ice segregation - ice segregation has raised the surface of peat plateaus, allowing thermokarst to occur
Herbivory - caribou graze lichens
Soil organic-matter accumulation - occurred in past but is now limited by dryness
Plant succession (Chapter 7)
Thermokarst - produces component 4 from this component; has resulted in 1 to 3 m of subsidence; increases after fire
Throughflow - mainly through porous surface peat
Wildfire - fires carry well across black spruce forest with dry lichens in this unit; a thick layer of peat may burn because it is often dry

Component 4: Thermokarst depressions

Setting

Area covered by component: 5 to 10% of map unit
Position on the landscape: depressions on glacial moraines
Geologic material: organic matter over lacustrine loam
Slope shape: concave or plane
Slope steepness: 0 to 1%

Soil

Soil name: Histosols, ponded (Chapter 6)
Soil profile:

Organic matter

Slightly decomposed
organic matter

Silt loam

Thickness of the organic mat: 100 cm or more
Water table (July-Aug): 0 to 5 cm from the surface
Redoximorphic features: low-chroma matrix in the mineral soil

Vegetation

Structure: (open low scrub)/graminoids/mosses; () = stratum may be absent, / = "over"
Major species: *Chamaedaphne calyculata, Carex spp., Sphagnum spp.*
Vegetation site type: Thermokarst depressions (Chapter 7)

Major Landscape-Forming Processes

Groundwater recharge - probably occurs in some depressions without permafrost
Soil organic-matter accumulation
Thermokarst - produces this component from components 1 and 3; has resulted in 1 to 3 m of subsidence

Component 5: Small stream flood plains

Setting

Area covered by component: 2 to 10% of map unit
Position on the landscape: channels on glacial moraines
Geologic material: alluvium
Slope shape: concave
Slope steepness: 1 to 5%

Soil

Soil profile:

Organic matter

Silt loam or stratified
silt and sand

Very or extremely gravelly
loam, sandy loam, or sand

Thickness of the organic mat: median 6 cm (range 0 to 15 cm)

Water table (Jul-Aug): occasionally present within 50 cm of the surface, and the soil is usually saturated within 50 cm of the surface

Depth to sand and gravel: median more than 50 cm (range 15 to more than 50 cm) from the mineral soil surface

Redoximorphic features: low-chroma matrix throughout the profile

Vegetation

Structure: (tall scrub)/closed low scrub/(gramnoids)/moss; () = stratum may be absent, / = "over"

Major species: *Salix spp., Vaccinium uliginosum, Calamagrostis canadensis, Drepanocladus spp.*

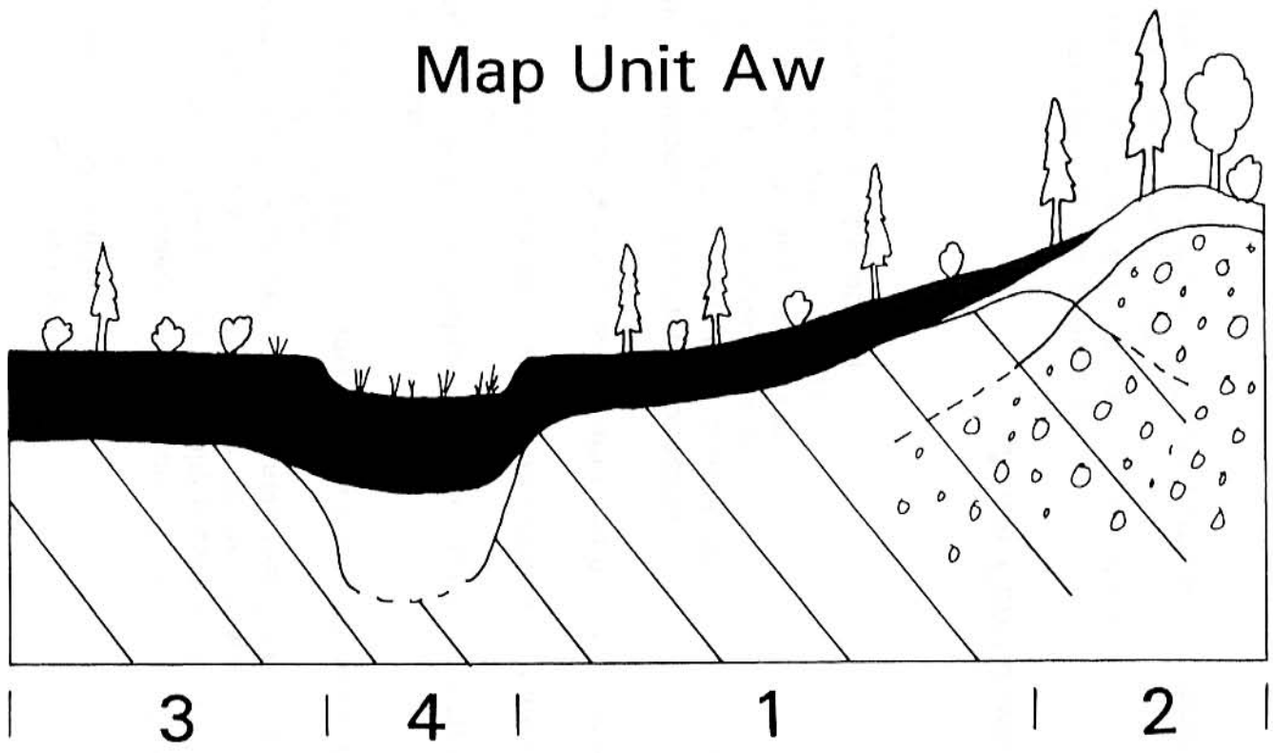
Vegetation site type: Small stream flood plains on moraines (Chapter 7)

Major Landscape-Forming Processes

Flooding - frequent; limits buildup of surface organic mat
Herbivory - moose browse willows
Icing - likely if drainage is blocked
Soil organic-matter accumulation
Plant succession (Chapter 7)
Throughflow

Minor Components

* Groundwater-discharge seep areas
* Moist depressions without peat or permafrost
* Fragments of river terraces
* Burned areas of component 1 with permafrost temporarily at more than 0.5 m depth



Aw ***Ambler moraines, wet***

1 Gentle slopes with permafrost
2 Dry knobs
3 Peat plateaus
4 Thermokarst depressions
5 Small stream floodplains

Organic matter

Loamy

Very to extremely gravelly

Permafrost

Fig. 6. Landscape diagram of map unit Aw

Ca = Colluvium and Ambler Till on Bedrock-Cored Hills

(Nat.'l Coop Soil Survey Name: Cryaquepts, loamy substratum - Cryochrepts, bedrock substratum - Cryochrepts, cool association, hilly)

Map unit setting: bedrock hills in the eastern half of the study area (Fig. 7). The Ambler glaciation streamlined the bedrock hills and deposited a thin layer of till. Landforms have since been modified by slope processes and soils enriched in silt by loess deposition. Elevation: 122 to 700 m (400 to 2300 feet) above sea level

Component 1: Wet lower- to mid-slopes

Setting

Area covered by component: 20 to 65% of map unit
Position on the landscape: middle and lower portions of slopes on glaciated bedrock uplands
Geologic material: organic matter over colluvium from loess, glacial till, and weathered bedrock
Slope shape: concave to plane
Slope steepness: 2 to 15%

Soil

Soil name: Cryaquepts, loamy substratum (Chapter 6)
Soil profile:

Organic matter

Silt loam, loam, sandy loam;
gravel and silt loam, loam,
or sandy loam

Permanently frozen: silt loam,
loam, sandy loam; gravel and
silt loam, loam, or sandy loam

Thickness of the organic mat: median 22 cm (range 10 to 44 cm)
Water table (Jul-Aug): occasionally present near the mineral soil surface, and the thawed mineral soil is often saturated
Depth to frozen soil (Jul-Aug): median 47 cm (range 34 to 67 cm)
Redoximorphic features: low-chroma matrix throughout the mineral soil

Vegetation

Structure: open needleleaf forest, woodland, or dwarf tree scrub/(tall scrub)/closed low scrub/(graminoids)/moss; () = stratum may be absent, / = "over"
Major species: *Picea mariana, Alnus crispa, Ledum palustre, Vaccinium uliginosum, Carex spp., Sphagnum spp.*
Vegetation site type: Striped colluvial slopes (Chapter 7)

Major Landscape-Forming Processes

Biochemical reduction
Cryoturbation and ice segregation - has produced broken soil horizons, mudboils, and earth hummocks
Flooding and alluviation - could occur as channels (component 5) wander across the slope
Herbivory - microtine sign present
Icing - likely if natural drainage is blocked
Soil organic-matter accumulation
Plant succession (Chapter 7)
Thermokarst - occurs locally; could occur widely if surface is disturbed
Throughflow - through surface organic mat
Wildfire - spreads readily in spruce forest on long, continuous slopes; moist lower portion of the organic mat usually survives fires

Component 2: Dry crests and upper slopes

Setting

Area covered by component: 5 to 25% of map unit
Position on the landscape: crests, shoulders, and upper slopes of glaciated bedrock uplands
Geologic material: loess over glacial till or weathered bedrock
Slope shape: convex to plane
Slope steepness: 0 to 25%

Soil

Soil name: Cryochrepts, bedrock substratum (Chapter 6)
Soil profile:

Organic matter

Silt loam, loam, sandy loam;
gravelly silt loam, loam, sandy loam

Very to extremely gravelly
silt loam, loam, sandy loam, or sand

Thickness of the organic mat: median 2 cm (range 0 to 8 cm)
Water table (Jul-Aug): none within 150 cm of the surface
Depth to very or extremely gravelly material: median 38 cm (range 0 to 60 cm) from the mineral soil surface surface
Depth to bedrock: estimated 0.5 to 1.5 m
Redoximorphic features: low-chroma mottles rarely present in loamy surface layer

Vegetation

Structure: open needleleaf or mixed forest or woodland/(open tall scrub)/low scrub/lichens; () = stratum may be absent, / = "over"
Major species: *Picea mariana, Populus tremuloides, Betula glandulosa, Ledum palustre, Vaccinium uliginosum, Cladina spp.*
Vegetation site type: Dry terraces and uplands (lichen woodland)(Chapter 7)

Major Landscape-Forming Processes

Herbivory - caribou graze lichens
Soil organic-matter accumulation - occurs but hindered by dryness
Plant succession (Chapter 7)
Wildfire - spreads readily in spruce forest on long, continuous slopes; organic surface layer may be consumed almost entirely by severe fires

Component 3: Moist upper slopes and crests with post-burn thaw

Setting

Area covered by component: 0 to 40% of map unit
Position on the landscape: crests, shoulders, and slopes of glaciated bedrock uplands; generally in areas burned within the past 100 years
Geologic material: loess over colluvium, glacial till, and weathered bedrock
Slope shape: convex, plane, or concave
Slope steepness: 0 to 20%

Soil

Soil name: Cryochrepts, cool (Chapter 6)
Soil profile:

Organic matter

Silt loam, loam;
gravelly loam

Very to extremely gravelly
loam or sandy loam

Thickness of the organic mat: median 7 cm (range 0 to 22 cm)
Water table (Jul-Aug): none within 150 cm of the structure
Depth to very or extremely gravelly material: median 80 cm (range 40 to more than 150 cm) from the mineral soil surface
Redoximorphic features: low-chroma mottles present in loamy surface soil; bodies of low-matrix material occasionally present also

Vegetation

Structure: open needleleaf forest or woodland/(tall scrub)/low scrub/(moss); () = stratum may be absent, / = "over"
Major species: *Picea mariana, Betula glandulosa, Ledum palustre, Vaccinium uliginosum, Polytrichum spp.*
Vegetation site type: Burn thaw-susceptible terraces and uplands (Chapter 7)

Major Landscape-Forming Processes

Biochemical reduction - occurs but temporarily less active due to lowered permafrost table
Cryoturbation and ice segregation - has produced broken soil horizons and earth hummocks. Temporarily less active due to lowered permafrost table
Soil organic-matter accumulation

Plant succession - facilitates eventual rise of the permafrost table and conversion to component 4 (Chapter 7)
Throughflow - through organic surface horizon
Wildfire - spreads readily in spruce forest on long, continuous slopes; deciduous post-fire vegetation is less flammable. This component forms by severe burn of component 4.

Component 4: Wet upper slopes and crests with permafrost

Setting

Area covered by component: 0 to 30% of map unit
Position on the landscape: crests, shoulders, and upper slopes of glaciated bedrock uplands
Geologic material: loess over colluvium from loess, glacial till, and weathered bedrock
Slope shape: convex to plane
Slope steepness: 0 to 25%

Soil

Soil name: Cryaquepts, loamy substratum (Chapter 6)
Soil profile:

Organic matter

Silt loam, loam

Silt loam, loam;
very to extremely gravelly
loam, or sandy loam

Permanently frozen:
silt loam, loam; very
to extremely gravelly
loam, or sandy loam

Thickness of the organic mat: median 13 cm (range 10 to 15 cm)
Water table (Jul-Aug): occasionally present near the mineral soil surface, and the thawed mineral soil is often saturated
Depth to frozen soil (Jul-Aug): median 48 cm (range 14 to 95 cm)
Depth to very or extremely gravelly material: median unknown (range 12 to more than 50 cm) from the mineral soil surface
Redoximorphic features: low-chroma matrix usually present, beginning within 30 cm of the mineral soil surface and extending downward

Vegetation

Structure: open needleleaf forest/open tall scrub/low scrub/moss; () = stratum may be absent, / = "over"
Major species: *Picea mariana, Betula glandulosa, Ledum plaustre, Vaccinium uliginosum, Sphagnum spp.*
Vegetation site type: Burn thaw-susceptible terraces and uplands (Chapter 7)

Major Landscape-Forming Processes

Biochemical reduction
Cryoturbation and ice segregation
Herbivory - microtine sign present
Soil organic-matter accumulation
Plant succession (Chapter 7)
Throughflow in organic surface layer
Wildfire - spreads readily in spruce forest on long, continuous slopes; organic surface layer may be consumed almost entirely by severe fires, at which point this component is converted to component 3.

Component 5: Small stream flood plains

Setting

Area covered by component: 5 to 15% of map unit
Position on the landscape: channels on slopes of glaciated bedrock uplands
Geologic material: alluvium and colluvium
Slope shape: plane to concave
Slope steepness: 5 to 20%

Soil

Soil profile:

Organic matter

Loam, silt loam, sandy loam

Very to extremely gravelly
silt loam, loam, sandy
loam, or sand

Thickness of the organic mat: median 9 cm (range 0 to 16 cm)
Water table (Jul-Aug): occasionally present near the mineral soil surface
Depth to gravelly material: median 45 cm (range 0 to 65 cm) from the mineral soil surface
Redoximorphic features: variable. Low-chroma mottles or matrix throughout the loamy material, or features not present

Vegetation

Structure: (needleleaf open forest or woodland)/tall scrub/low scrub/forbs or moss; () = stratum may be absent, / = "over"
Major species: *Picea glauca, Alnus crispa, Salix spp., Vaccinium uliginosum*
Vegetation site type: Small stream flood plains in bedrock uplands (Chapter 7)

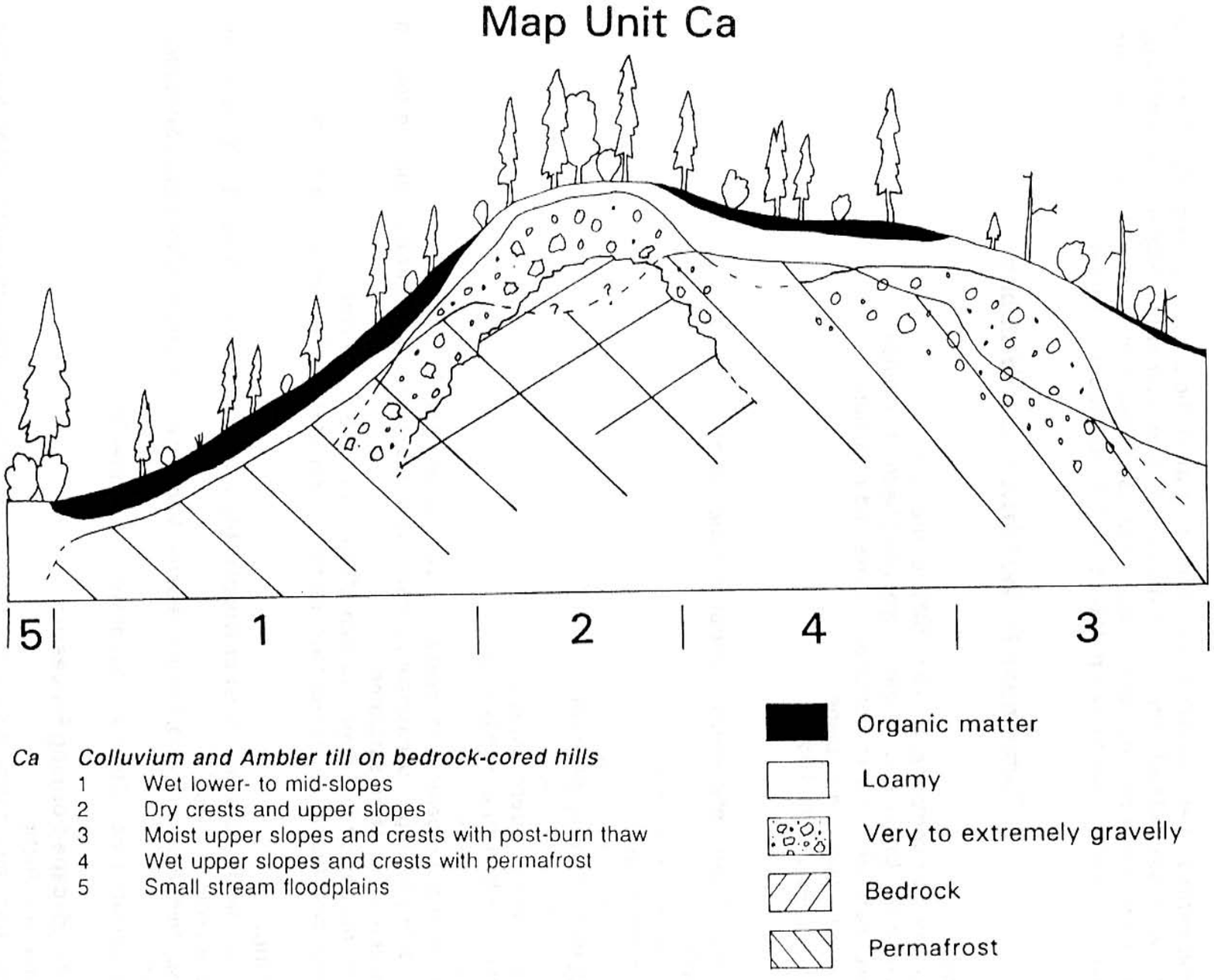
Major Landscape-Forming Processes

Biochemical reduction
Flooding and alluviation - frequent; prevents buildup of a thick surface organic mat
Herbivory - moose browse willows
Icing - likely if natural drainage is blocked

Soil organic-matter accumulation
Throughflow

Minor Components

*Soils with permafrost and very to extremely gravelly material at the surface
*Slopes steeper than 25%
*Rock outcrops
*Thermokarst depressions in component 1
*Lower slopes with south aspect and no permafrost



Ca ***Colluvium and Ambler till on bedrock-cored hills***

1 Wet lower- to mid-slopes
2 Dry crests and upper slopes
3 Moist upper slopes and crests with post-burn thaw
4 Wet upper slopes and crests with permafrost
5 Small stream floodplains

Fig. 7. Landscape diagram of map unit Ca.

Ck = Colluvium and Kobuk Till on Bedrock-Cored Hills

(Nat.'l Coop Soil Survey name: Cryaquepts, loamy substratum - Cryochrepts, cool - Cryochrepts, bedrock substratum association, hilly)

Map unit setting: bedrock hills in the southern part of the study area (Fig. 8). The Kobuk glaciation streamlined bedrock and deposited a thin layer of till. Slopes have since been greatly modified by slope processes. Loess is at least 1 m thick over most of the map unit. Elevation: 152 to 579 m (500 to 1900 feet) above sea level

Component 1: Wet lower- to mid-slopes

Setting

Area covered by component: 40 to 50% of map unit
Position on the landscape: slopes of glaciated bedrock uplands
Geologic material: organic matter over loess and colluvium
Slope shape: concave to plane
Slope steepness: 3 to 10%

Soil

Soil name: Cryaquepts, loamy substratum (Chapter 6)
Soil profile:

Organic matter

Silt loam, gravelly silt loam

Permanently frozen: silt loam;
gravelly silt loam or sandy loam

Thickness of the organic mat: median 25 cm (range 13 to 45 cm)
Water table (Jul-Aug): occasionally present near the mineral soil surface, and the thawed mineral soil is often saturated.
Depth to frozen soil (Jul-Aug): median 50 cm (range 38 to 80 cm)
Redoximorphic features: low-chroma matrix usually present throughout the soil profile

Vegetation

Structure: needleleaf open forest or woodland/low scrub/graminoids/moss; () = stratum may be absent, / = "over"
Major species: *Picea mariana, Ledum palustre, Vaccinium uliginosum, Carex spp., Sphagnum spp.*
Vegetation site type: Striped colluvial slopes (Chapter 7)

Major Landscape-Forming Processes

Biochemical reduction
Cryoturbation and ice segregation - has produced earth hummocks and deformed soil horizons
Herbivory - microtine use likely
Icing - likely if natural drainage is blocked

Soil organic-matter accumulation
Plant succession (Chapter 7)
Solifluction (past) - probably occurred during the Pleistocene and produced the long, smooth slopes
Thermokarst - occurs locally and could become widespread if surface is disturbed
Throughflow - through the surface organic mat
Wildfire - spreads readily in spruce forest on long, continuous slopes; moist lower portion of the organic mat usually survives fires

Component 2: Moist upper slopes and summits with post-burn thaw

Setting

Area covered by component: 25 to 35% of map unit
Position on the landscape: crests, shoulders, and upper slopes of glaciated bedrock uplands; generally in areas burned within the past 100 years
Geologic material: loess over glacial till, weathered bedrock, or colluvium
Slope shape: convex to plane
Slope steepness: 3 to 8%

Soil

Soil name: Cryochrepts, cool (Chapter 6)
Soil profile:

Organic matter

Silt loam, sandy loam, or
gravelly silt loam

Very to extremely gravelly
silt loam, sandy loam, or sand

Thickness of the organic mat: median 10 cm (range 4 to 12 cm)
Water table (Jul-Aug): none within 150 cm of the surface
Depth to very gravelly material: median 100 cm (range 90 to more than 150 cm) from the mineral soil surface
Redoximorphic features: low-chroma mottles sometimes present in the loamy surface soil

Vegetation

Structure: open needleleaf forest or woodland/low scrub/(lichens); () = stratum may be absent, / = "over"
Major species: *Picea mariana, Ledum palustre, Vaccinium uliginosum, Cladonia spp.*
Vegetation site type: Burn thaw-susceptible terraces and uplands (Chapter 7)

Major Landscape-Forming Processes

Biochemical reduction - cccurs but weak due to lowering of permafrost table after burn
Cryoturbation and ice segregation - temporarily less active due to lowering of permafrost table after burn
Soil organic-matter accumulation

Plant succession - should facilitate rise of permafrost table with time (Chapter 7)
Wildfire - spreads readily in spruce forest on long, continuous slopes; post-fire deciduous vegetation is less flammable; this component formed by post-burn thaw of soil.

Component 3: Dry crests and upper slopes

Setting

Area covered by component: 10 to 20% of map unit
Position on the landscape: crests and shoulders of glaciated bedrock uplands
Geologic material: loess over glacial till or weathered bedrock
Slope shape: convex
Slope steepness: 0 to 12%

Soil

Soil name: Cryochrepts, bedrock substratum (Chapter 6)
Soil profile:

Organic matter

Silt loam, loam

Very to extremely gravelly
loam, sandy loam, silt loam

Thickness of the organic mat: median 6 cm (range 3 to 15 cm)
Water table (Jul-Aug): none within 150 cm of the surface
Depth to gravelly material: median 28 cm (range 20 to 70 cm) from the mineral soil surface
Depth to bedrock: Estimated 1 to 2 m
Redoximorphic features: low-chroma mottles often present in the loamy surface soil

Vegetation

Structure: open needleleaf or mixed forest or woodland/low scrub/(moss and lichens); () = stratum may be absent, / = "over"
Major species: *Picea mariana, Populus tremuloides, Ledum palustre, Vaccinium uliginosum, Polytrichum spp., Cladina spp.*
Vegetation site type: Dry terraces and uplands (lichen woodland)(Chapter 7)

Major Landscape-Forming Processes

Biochemical reduction - occurs but weak due to good dranage
Soil organic-matter accumulation - occurs but hindered by dryness
Plant succession (Chapter 7)
Wildfire - spreads readily in spruce forest on long, continuous slopes; organic surface layer may be consumed almost entirely by severe fires

Component 4: Small stream flood plains

Setting

Area covered by component: 10 to 15% of map unit
Position on the landscape: channels on slopes of glaciated bedrock uplands
Geologic material: alluvium and colluvium
Slope shape: plane to concave
Slope steepness: 5 to 20%

Soil

Soil profile:

Organic matter

Loam, silt loam, sandy loam

Very to extremely gravelly
silt loam, loam, sandy
loam, or sand

Thickness of the organic mat: median 9 cm (range 0 to 16 cm)
Water table (Jul-Aug): occasionally present near the mineral soil surface
Depth to gravelly material: median 45 cm (range 0 to 65 cm) from the mineral soil surface
Redoximorphic features: variable. Low-chroma mottles or matrix throughout the loamy material, or features not present

Vegetation

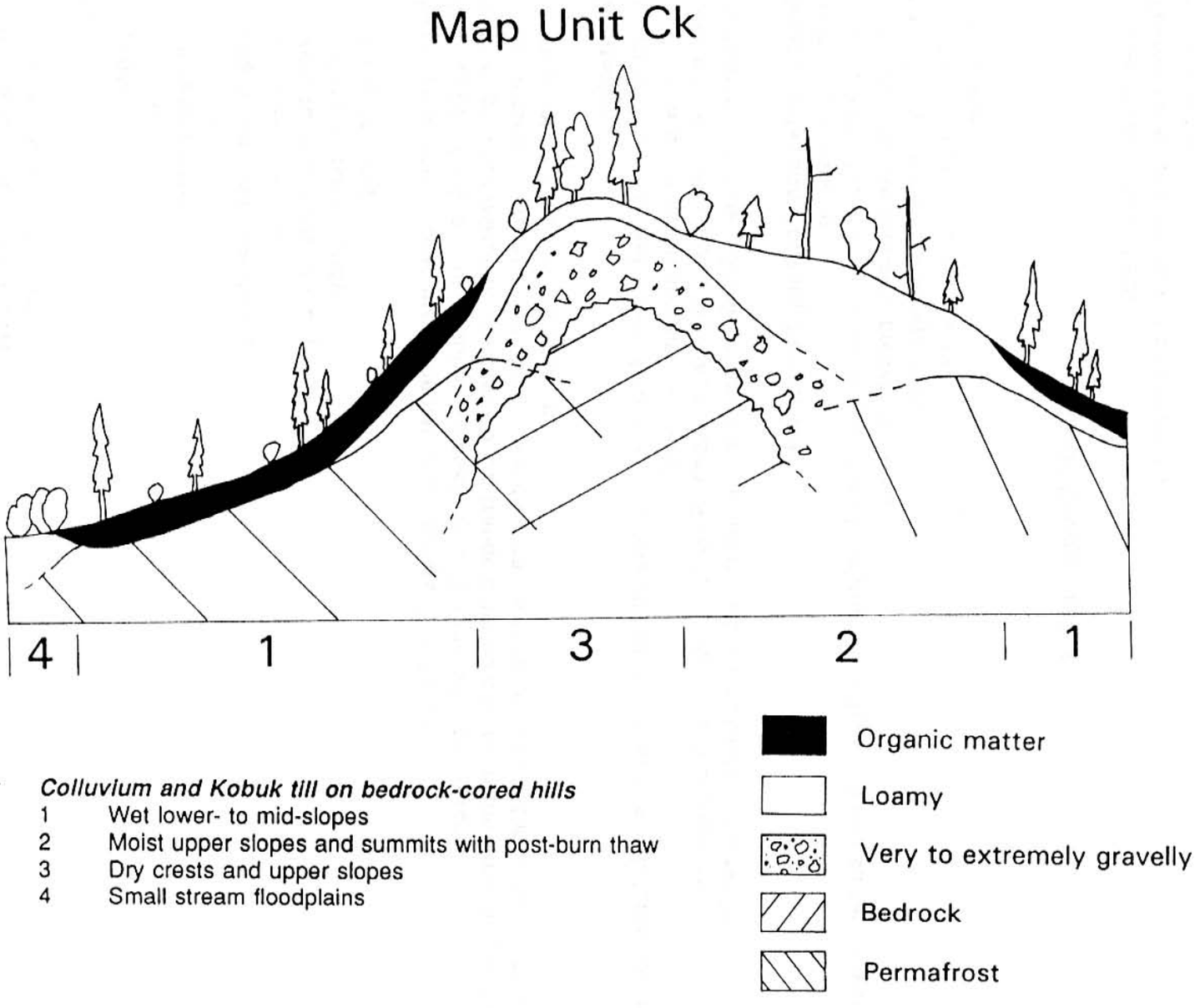
Structure: (needleleaf open forest or woodland)/tall scrub/low scrub/forbs or moss; () = stratum may be absent, / = "over"
Major species: *Picea glauca, Alnus crispa, Salix spp., Vaccinium uliginosum*
Vegetation site type: Small stream flood plains in bedrock uplands (Chapter 7)

Major Landscape-Forming Processes

Biochemical reduction
Flooding and alluviation - frequent; prevents formation of a thick organic surface layer
Herbivory - moose probably browse willows
Icing - likely if natural drainage is blocked
Soil organic-matter accumulation
Throughflow

Minor Components

*Slopes steeper than 12%
*Thermokarst depressions in component A
*Rock outcrops



Ck ***Colluvium and Kobuk till on bedrock-cored hills***

1 Wet lower- to mid-slopes
2 Moist upper slopes and summits with post-burn thaw
3 Dry crests and upper slopes
4 Small stream floodplains

Fig. 8. Landscape diagram of map unit Ck.

Cs = Colluvial Slopes

(Nat.'l Coop Soil Survey name: Cryaquepts, loamy substratum - Cryofluvents, hillslopes - Typic Cryochrepts, loamy-skeletal association, moderately steep)

Map unit setting: middle and lower slopes of bedrock highlands; in areas covered by slope sediments with few or no bedrock outcrops (Fig. 9). Elevation: 122 to 762 m (400 to 2500 feet) above sea level.

Component 1: Striped colluvial slopes

Setting

Area covered by component: 40 to 80% of map unit
Position on the landscape: middle and lower slopes of bedrock-cored uplands
Geologic material: organic matter over colluvium
Slope shape: concave to plane
Slope steepness: 5 to 20%

Soil

Soil name: Cryaquepts, loamy substratum (Chapter 6)
Soil profile:

Organic matter

Silt loam, loam, sandy loam;
very gravelly loam or sandy loam;
extremely gravelly sandy loam

Permanently frozen: silt loam,
loam, sandy loam;
very gravelly loam or sandy loam;
extremely gravelly sandy loam

Thickness of the organic mat: median 18 cm (range 12 to 28 cm)
Water table (Jul-Aug): occasionally present near the mineral soil surface, and the thawed mineral soil is usually saturated
Depth to frozen soil (Jul-Aug): median 43 cm (range 29 to 61 cm)
Redoximorphic features: low-chroma mottles or low-chroma matrix throughout the mineral soil profile

Vegetation

Structure: needleleaf open forest or woodland/(tall scrub)/closed low scrub/mosses; () = stratum may be absent, / = "over"
Major species: *Picea mariana, Alnus crispa, Ledum palustre, Vaccinium uliginosum, Sphagnum spp.*
Vegetation site type: Striped colluvial slopes (Chapter 7)

Major Landscape-Forming Processes
Biochemical reduction
Cryoturbation and ice segregation
Flooding and alluviation - currently none; could occur in the future as channels (component 2) migrate across the slope
Groundwater discharge - occurs locally at the base of slopes
Herbivory - microtine sign present
Icing - potential if natural drainage is blocked
Soil organic-matter accumulation
Plant succession (Chapter 7)
Solifluction - active where the map unit extends above treeline near Selby Lake; was probably common throughout this unit during the Pleistocene
Thermokarst - potential if surface is disturbed
Throughflow - through organic surface layer
Wildfire - black spruce forest is flammable, but spread is inhibited by firebreaks of deciduous brush (component 2)

Component 2: Small stream flood plains

Setting
Area covered by component: 10 to 45% of map unit
Position on the landscape: backslopes of bedrock-cored uplands
Geologic material: colluvium or alluvium
Slope shape: plane
Slope steepness: 5 to 25%

Soil
Soil name: Cryofluvents, hillslopes (Chapter 6)
Soil profile:

Organic matter

Silt loam, loam, sandy loam,
or gravelly loam

Very to extremely gravelly
silt loam, loam, or sandy loam

Thickness of the organic mat: median 8 cm (range 0 to 14 cm)
Water table (Jul-Aug): commonly present within 50 cm of the surface
Depth to very or extremely gravelly material: median 20 cm (range 0 to 70 cm) from the mineral soil surface
Redoximorphic features: loamy soil material occasionally has low-chroma matrix

Vegetation
Structure: mixed or needleleaf open forest/closed tall scrub/low scrub/forbs; () = stratum may be absent, / = "over"
Major species: *Picea glauca, Betula papyrifera, Alnus crispa, Salix spp., Vaccinium uliginosum*

Vegetation site type: Small stream flood plains in bedrock uplands (Chapter 7)

Major Landscape-Forming Processes
Biochemical reduction
Flooding and alluviation - frequent; prevents buildup of a thick surface organic mat
Herbivory - moose browse willows
Icing - potential if natural drainage is blocked
Soil organic-matter accumulation
Plant succession (Chapter 7)
Throughflow

Component 3: Gravelly slopes

Setting
Area covered by component: 0 to 30% of map unit
Position on the landscape: mid to lower slopes of bedrock-cored uplands
Geologic material: colluvium
Slope shape: plane
Slope steepness: 8 to 35%

Soil
Soil name: Typic Cryochrepts, loamy-skeletal (Chapter 6)
Soil profile:

Organic matter

Silt loam, loam;
gravelly loam, sandy loam

Very to extremely gravelly
loam or sandy loam

Thickness of the organic mat: median 12 cm (range 10 to 18 cm)
Water table (Jul-Aug): none within 150 cm of the surface
Depth to very or extremely gravelly material: median 28 cm (range 0 to 60 cm) from the mineral soil surface
Redoximorphic features: none

Vegetation
Structure: needleleaf or mixed open forest/(tall scrub)/low scrub/moss; () = stratum may be absent, / = "over"
Major species: *Picea mariana, Betula papyrifera, Alnus crispa, Betula glandulosa, Spiraea beauverdiana, Vaccinium uliginosum, Hylocomium splendens, Pleurozium schreberi*
Vegetation site type: Gravelly colluvium (Chapter 7)

Major Landscape-Forming Processes
Groundwater discharge - occurs locally at the base of slopes
Soil organic-matter accumulation

Plant succession (Chapter 7)
Throughflow - in surface organic layer
Wildfire - fires carried well by black spruce forest, but spread is inhibited by firebreaks of deciduous brush (component 2)

Component 4: Alluvial fans

Setting

Area covered by component: 0 to 20% of map unit
Position on the landscape: alluvial fans at the foot of bedrock upland slopes
Geologic material: alluvium
Slope shape: plane
Slope steepness: 3 to 8%

Soil

Soil name: Cryochrepts, shallow (Chapter 6)
Soil profile:

Organic matter

Silt loam, loam, sandy loam;
gravelly silt loam,

Extremely gravelly loam, sandy
loam, loamy sand, or sand

Thickness of the organic mat: median 7 cm (range 0 to 18 cm)
Water table (Jul-Aug): none within 150 cm of the surface
Depth to extremely gravelly material: median 52 cm (range 18 to 60 cm) from the mineral soil surface
Redoximorphic features: low-chroma mottles often present in the loamy surface soil

Vegetation

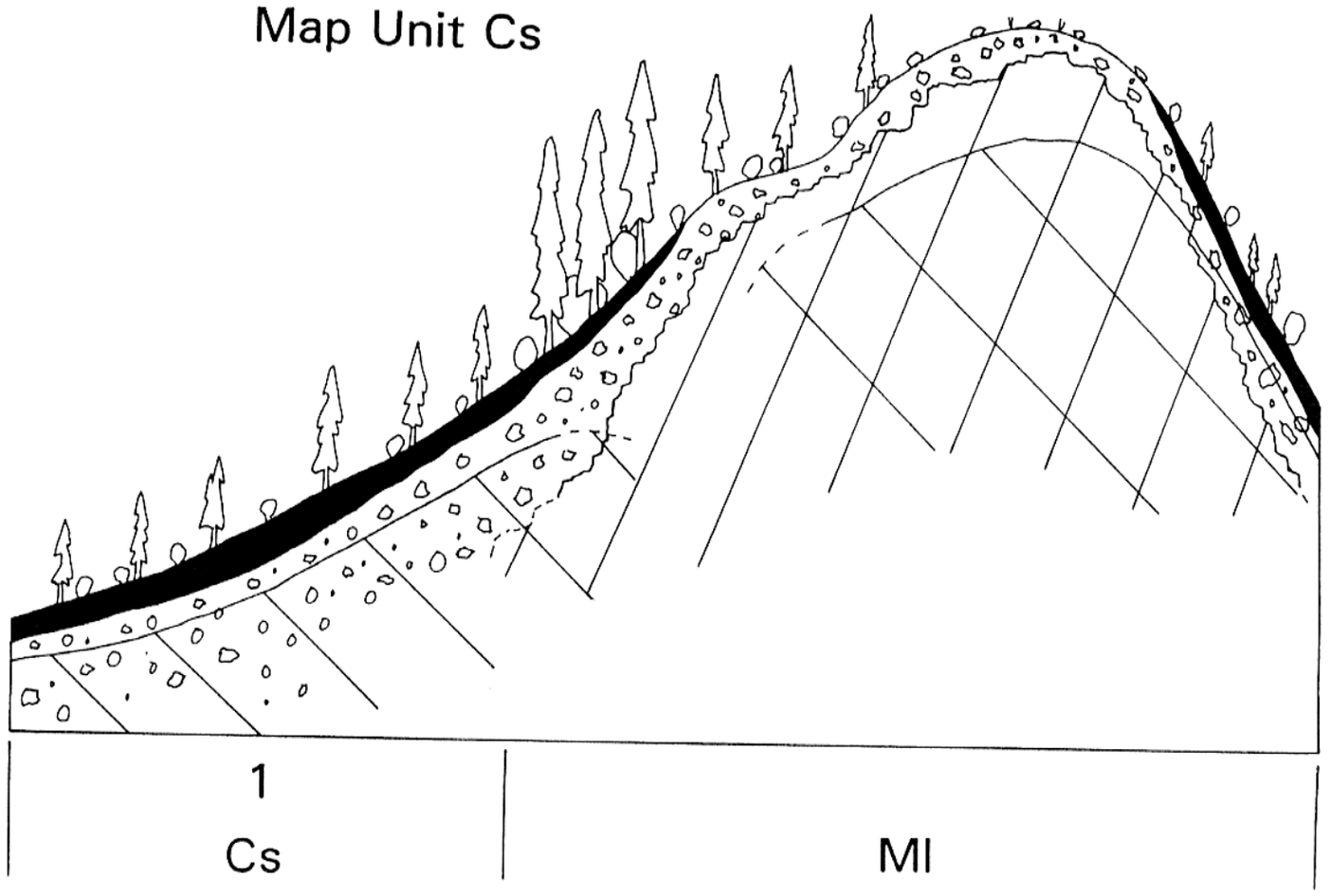
Structure: needleleaf or mixed open forest/(tall scrub)/low scrub; () = stratum may be absent, / = "over"
Major Species: *Picea mariana, Populus tremuloides, Betula glandulosa, Ledum palustre, Vaccinium uliginosum*
Vegetation site type: Dry terraces and uplands (lichen woodland)(Chapter 7)

Major Landscape-Forming Processes

Biochemical reduction - occurs but weak due to good drainage
Flooding and alluviation - possible as channels migrate across the slope
Soil organic-matter accumulation - occurs but hindered by dryness
Plant succession (Chapter 7)
Wildfire - spreads readily in black spruce forest

Minor Components

*Pingos
*Bedrock knobs
*Ridges of glacial till or outwash



Cs ***Colluvial slopes***

1 Striped colluvial slopes
2 Small stream floodplains
3 Gravelly slopes
4 Alluvial fans

Organic matter
Very to extremely gravelly
Bedrock
Permafrost

Fig. 9. Landscape diagram of map unit Cs

Fc = Creek Flood Plains

(Nat.'l Coop Soil Survey name: Pergelic Cryaquepts - Typic Cryaquents - Cryofluvents Association)

Map unit setting: nearly level areas along small streams (Beaver Creek, Akpelik Creek, etc.). Elevation: 107 to 274 m (350 to 900 feet) above sea level.

Component 1: Moist flood plain with permafrost

Setting

Area covered by component: 10 to 80% of map unit
Position on the landscape: on small stream flood plains, usually separated from the channel by other components
Geologic material: alluvium
Slope shape: plane
Slope steepness: 0 to 2%

Soil

Soil name: Pergelic Cryaquepts (Chapter 6)
Soil profile:

Organic matter

Stratified silt and fine sand

Permanently frozen silt
and fine sand

Thickness of the organic mat: median 10 cm (range 8 to 24 cm)
Water table (Jul-Aug): occasionally present within 50 cm of the surface
Depth to frozen soil (Jul-Aug): median 54 cm (range 38 to 58 cm) from the mineral soil surface
Redoximorphic features: low-chroma matrix begins in the upper 40 cm and extends down into the frozen soil; low-chroma mottles above this

Vegetation

Structure: open needleleaf or mixed forest/tall scrub/low scrub/moss; () = stratum may be absent, / = "over"
Major species: *Picea glauca, Betula papyrifera, Alnus crispa, Salix spp., Vaccinium uliginosum, Hylocomium splendens*
Vegetation site type: Frozen flood plain of creeks (Chapter 7)

Major Landscape-Forming Processes

Biochemical reduction - in saturated silt and sand
Flooding and alluviation - occasional to rare
Herbivory - browsing by moose
Icing - possible if natural streamflow is obstructed

Soil organic-matter accumulation
Plant succession (Chapter 7)
Riverbank erosion - occurs mainly on the outside of meander bends as the channel migrates

Component 2: Unfrozen wet areas and depressions

Setting

Area covered by component: 5 to 80% of map unit
Position on the landscape: low portions of flood plains and depressions on flood plains
Geologic material: alluvium
Slope shape: plane
Slope steepness: 0 to 2%

Soil

Soil name: Typic Cryaquents (Chapter 6)
Soil profile:

Organic matter

Stratified sand and silt

Sand and gravel

Thickness of the organic mat: median 10 cm (range 0 to 13 cm)
Water table (Jul-Aug): often present within 1 m of the surface
Depth to sand and gravel: median 65 cm (range 35 to 110 cm) from the mineral soil surface
Redoximorphic features: low-chroma matrix throughout the loamy surface layer

Vegetation

Structure: (open needleleaf forest)/tall scrub/(low scrub)/graminoids or forbs/(moss); () = stratum may be absent, / = "over"
Major species: *Picea glauca, Salix spp., Vaccinium uliginosum, Calamagrostis canadensis*
Vegetation site type: Wet flood plain depressions (Chapter 7)

Major Landscape-Forming Processes

Biochemical reduction - in saturated silt and sand
Flooding and alluviation - occasional to rare; hinders buildup of thick organic mats
Herbivory - browsing by moose
Icing - possible if natural streamflow is obstructed
Soil organic-matter accumulation
Plant succession (Chapter 7)
Riverbank erosion - occurs mainly on the outside of meander bends as the channel migrates

Component 3: Dry flood plain

Setting

Area covered by component: 0 to 70% of map unit

Position on the landscape: small stream flood plains
Geologic material: alluvium
Slope shape: plane
Slope steepness: 0 to 2%

Soil

Soil name: Cryofluvents (Chapter 6)
Soil profile:

Organic matter
---
stratified silt and sand
---
sand and gravel

Thickness of the organic mat: median 9 cm (range 0 to 16 cm)
Water table (Jul-Aug): none within 150 cm of the surface
Depth to sand and gravel: median 70 cm (range 30 to 110 cm) from the mineral soil surface
Redoximorphic features: low-chroma mottles occasionally present in the upper 0.5 m

Vegetation

Structure: open needleleaf or mixed forest/tall or low scrub/moss; () = stratum may be absent, / = "over"
Major species: *Picea glauca, Betula papyrifera, Alnus crispa, Rosa acicularis, Vaccinium vitis-idaea, Hylocomium splendens*
Vegetation site type: Dry flood plain, small streams (Chapter 7)

Major Landscape-Forming Processes

Biochemical reduction - occurs but weak
Flooding and alluviation - occasional to rare
Herbivory - browsing by moose
Icing - possible if natural streamflow is obstructed
Soil organic-matter accumulation - could eventually convert some areas to component 1
Plant succession (Chapter 7)
Riverbank erosion - occurs mainly on the outside of meander bends as the channel migrates

Minor Components

*gravel bars
*inactive channels
*areas with sand and gravel at the surface
*open water

Fr = River Flood Plains

(Nat.'l Coop Soil Survey name: Pergelic Cryaquepts - Cryofluvents - Typic Cryorthents association)

Map unit setting: Nearly level areas affected by flooding along the Kobuk and Reed Rivers (Fig. 10). Elevation: 91 to 213 m (300 to 700 feet) above sea level. A combination of processes facilitate conversion of component 3 to 2 to 4 to 1 over the long term. These processes include: accumulation of silt and fine sand (with consequent increase in soil water-holding capacity, raising of the surface, and as a result of the latter, decrease in flooding frequency), accumulation of a surface soil organic mat, and plant succession. However, soil erosion and mechanical damage to plants during floods can maintain components 3 and 2 essentially indefinitely, or convert components 4 and 1 back to 3 or 2 with changes in river course.

Component 1: Rarely flooded areas with permafrost

Setting

Area covered by component: 30 to 80% of map unit
Position on the landscape: flood plains, on higher surfaces than components 2 and 3 and generally further from the river than other components
Geologic material: alluvium
Slope steepness: 0 to 2%
Slope shape: plane

Soil

Soil name: Pergelic Cryaquepts (Chapter 6)
Soil profile:

Organic matter

Stratified silt and sand with
thin buried organic layers

Permanently frozen
stratified silt and sand

Permanently frozen sand and gravel

Thickness of the organic mat: median 13 cm (range 5 to 22 cm)
Water table (Jul-Aug): occasionally present within 80 cm of the surface
Depth to frozen soil (Jul-Aug): median 48 cm (range 30 to 89 cm)
Depth to sand and gravel: median 110 cm (range 70 to 200 cm) from the mineral soil surface
Redoximorphic features: low-chroma matrix throughout the stratified silt and sand

Vegetation

Structure: needleleaf open forest or woodland, or dwarf tree scrub/(open tall scrub)/closed low scrub/moss; () = stratum may be absent, / = "over"
Major species: *Picea mariana, Ledum palustre, Vaccinium uliginosum, Hylocomium splendens*

Vegetation site type: Rarely flooded river flood plain with permafrost (Chapter 7)

Major Landscape-Forming Processes

Biochemical reduction - in saturated stratified silt and sand
Flooding and alluviation - rare (to occasional); low frequency allows an organic mat to form; continued alluviation buries organic layers
Herbivory - willows browsed by moose; microtine sign common
Ice-scour - may occur where component is located on the riverbank.
Soil organic-matter accumulation
Plant succession (Chapter 7)
Riverbank erosion - occurs mainly on the outside of meander bends as the channel migrates
Wildfire - black spruce forest carries fires well, but is partially protected by adjacent natural firebreaks (gravel bars, open water, sloughs, deciduous shrubs and trees).

Component 2: Dry occasionally flooded areas (tall scrub and poplar forest)

Setting

Area covered by component: 5 to 40% of map unit
Position on the landscape: low portions of flood plains bordering the river channel or gravel bars; higher than component 3
Geologic material: alluvium
Slope steepness: 0 to 2%
Slope shape: plane

Soil

Soil name: Cryofluvents (Chapter 6)
Soil profile:

Organic matter

Stratified silt and sand
with thin buried organic
layers

Sand and gravel

Thickness of the organic mat: median 0 cm (range 0 to 7 cm)
Depth to sand and gravel: median 30 cm (range 10 to 75 cm) from the mineral soil surface
Water table (Jul-Aug): none within 150 cm of the surface
Redoximorphic features: none

Vegetation

Structure: broadleaf or mixed forest, or tall scrub/graminoids or forbs; () = stratum may be absent, / = "over"
Major species: *Populus balsamifera, Salix alaxensis, Alnus spp., Calamagrostis canadensis, Galium boreale, Mertensia paniculata*
Vegetation site type: Dry occasionally flooded river flood plain (tall scrub and poplar forest)(Chapter 7)

Major landscape-forming processes

Flooding and alluviation - occasional (to frequent); alluviation prevents formation of a thick surface organic layer; alluviation raises the surface, which decreases flooding frequency in the long term and can facilitate conversion of this component to component 4.
Herbivory - browsing by moose
Ice-scour - occurs during spring breakup floods; damages vegetation and helps to maintain vegetation of shrubs and herbs.
Soil organic-matter accumulation
Plant succession (Chapter 7)
Riverbank erosion - occurs mainly on the outside of meander bends as the channel migrates

Component 3: Gravel bars, frequently flooded

Setting

Area covered by component: 5 to 15% of map unit
Position on the landscape: low portions of flood plains bordering the river channel
Geologic material: alluvium
Slope steepness: 0 to 2%
Slope shape: plane

Soil

Soil name: Typic Cryorthents (Chapter 6)
Soil profile:

Stratified silt and sand

Sand and gravel

Depth to sand and gravel: median 0 cm (range 0 to 7 cm)
Water table (Jul-Aug): none within 100 cm of the surface
Redoximorphic features: none

Vegetation

Structure: unvegetated, or open tall scrub/graminoids; () = stratum may be absent, / = "over"
Major Species: *Salix alaxensis, Agropyron spp., Artemesia tilesii, Hedysarum alpinum*
Vegetation site type: Gravel bars, frequently flooded (Chapter 7)

Major Landscape-Forming Processes

Flooding and alluviation - frequent; alluviation prevents formation of a surface organic layer.
Herbivory - browsing by moose
Ice-scour - occurs during spring breakup floods; damages vegetation and helps to maintain vegetation of shrubs and herbs.
Plant succession (Chapter 7)
Riverbank erosion

Component 4: Dry occasionally flooded areas (white spruce/alder forest)

Setting

Area covered by component: 5 to 15% of map unit
Position on the landscape: flood plains, on higher surfaces than components 2 and 3
Geologic material: alluvium
Slope steepness: 0 to 2%
Slope shape: plane

Soil

Soil name: Cryofluvents (Chapter 6)
Soil profile:

Organic matter

Stratified silt and sand
with thin buried organic
layers

Sand and gravel

Thickness of the organic mat: median 7 cm (range 3 to 10 cm)
Depth to sand and gravel: median 50 cm (range 25 to more than 150 cm) from the mineral soil surface
Water table (Jul-Aug): none within 150 cm of the surface
Depth to frozen soil (Jul-Aug): occasionally present below 50 cm depth
Redoximorphic features: low-chroma mottles occasionally present in the stratified silt and sand

Vegetation

Structure: needleleaf open forest or woodland/tall scrub/low scrub/moss or forbs; () = stratum may be absent, / = "over"
Major species: *Picea glauca, Alnus crispa, Rosa acicularis, Linnaea borealis, Hylocomium splendens*
Vegetation site type: Dry, occasionally flooded river flood plain (white-spruce/alder forest)(Chapter 7)

Major Landscape-Forming Processes

Flooding and alluviation - occasional (to rare); alluviation inhibits formation of a thick surface organic layer; in the long term facilitates thickening of the loamy surface layer, raising of the surface, and thus a decrease in flooding frequency
Herbivory - browsing by moose
Ice-scour - may occur where component occurs on the riverbank.
Soil organic-matter accumulation - facilitates formation of permafrost and conversion of this component to Component 1
Plant succession (Chapter 7)
Riverbank erosion - occurs mainly on the outside of meander bends as the channel migrates

Component 5: Wet depressions and channels

Setting

Area covered by component: 5 to 15% of map unit
Position on the landscape: depressions and inactive channels on flood plains
Geologic material: alluvium
Slope steepness: 0 to 2%
Slope shape: plane to concave

Soil

Soil name: Typic Cryaquents (Chapter 6)
Soil profile:

Organic matter

Stratified silt and sand with
thin buried organic layers

Sand and gravel

Thickness of the organic mat: median 6 cm (range 2 to 30 cm)
Water table (Jul-Aug): occasionally present within 50 cm of the surface
Depth to frozen soil (Jul-Aug): mostly unfrozen; locally has permafrost about 0.5 m from the mineral soil surface
Depth to sand and gravel: median 50 cm (range 10 to 90 cm) from the mineral soil surface
Redoximorphic features: low-chroma matrix throughout the stratified silt and sand

Vegetation

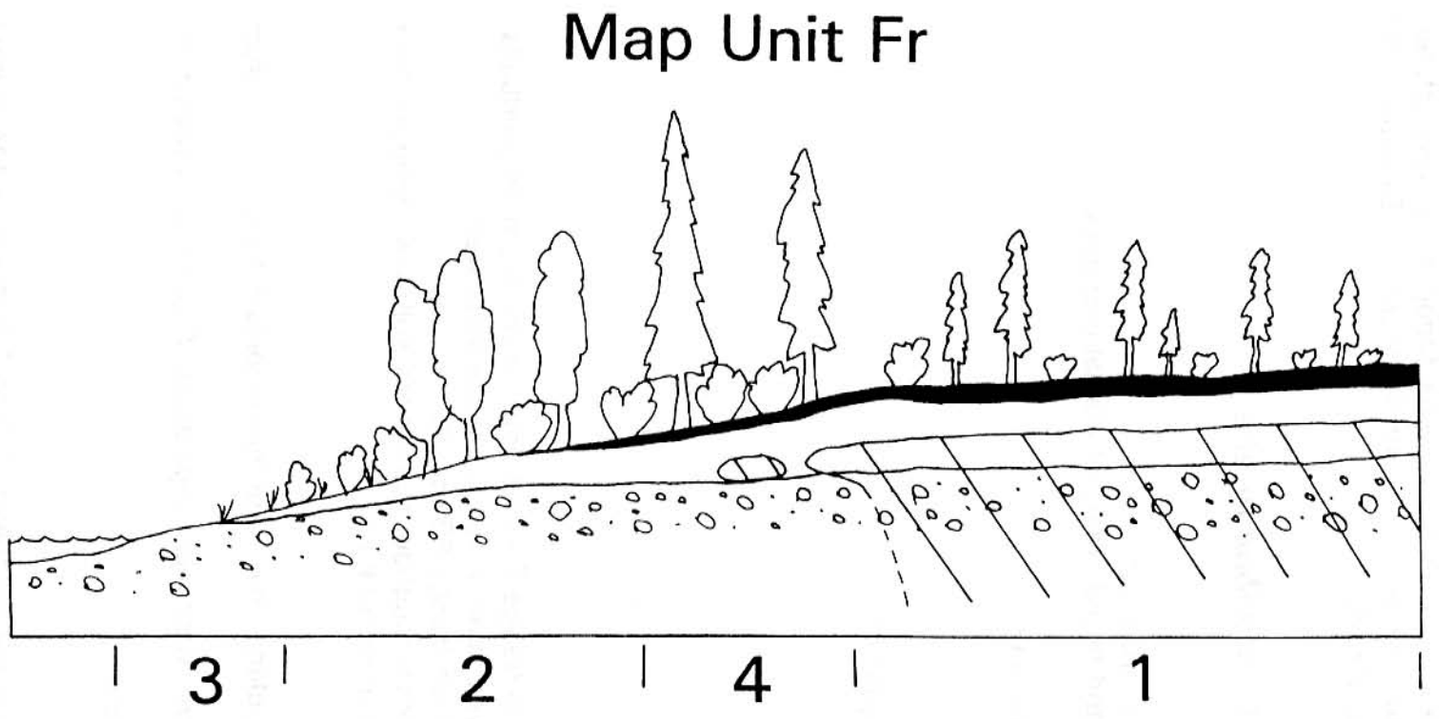
Structure: open tall or low scrub/graminoids or moss; () = stratum may be absent, / = "over"
Major species: *Salix spp., Vaccinium uliginosum, Calamagrostis canadensis*
Vegetation site type: Wet flood plain depressions (Chapter 7)

Major Landscape-Forming Processes

Biochemical reduction - in saturated stratified silt and sand
Flooding and alluviation - rare to occasional; floodwaters stagnate and persist in depressions, preventing tree growth
Herbivory - willows browsed by moose
Soil organic-matter accumulation - burial by alluvium inhibits formation of a thick organic layer
Plant succession (Chapter 7)

Minor Components

*Sandy and gravelly spots in components 1, 4 and 5
*Ponds and organic soils in depressions
*Fragments of higher terraces (map units Td and Tw)



Fr ***River floodplains***

1 Rarely flooded areas with permafrost
2 Dry, occasionally flooded areas (tall scrub and poplar forest)
3 Gravel bars, frequently flooded
4 Dry, occasionally flooded areas (white spruce/alder forest)
5 Wet depressions and channels

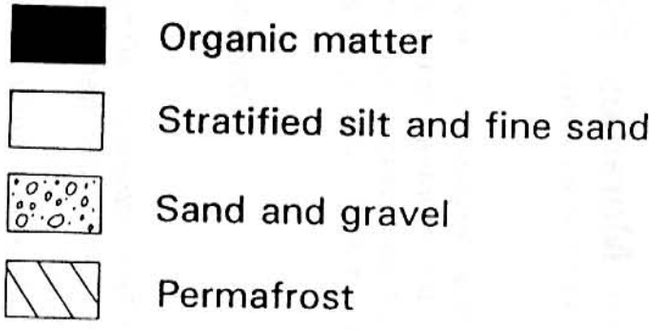


Fig. 10. Landscape diagram of map unit Fr.

Ke = Kobuk Moraines, Ecotonal (lowland tundra-forest)

(Nat.'l Coop Soil Survey name: Pergelic Cryaquepts, silty - Cryochrepts, silty association, rolling)

Map unit setting: lowlands in the western part of the study area (Fig. 11). Kobuk moraines are the oldest moraines in the study area. As a result, morainal topography is completely obliterated and loess is more than 1 m thick over most of the moraine. Elevation: 91 to 305 m (300 to 1000 feet) above sea level.

Component 1: Mudboil tundra

Setting

Area covered by component: 30 to 40% of map unit
Position on the landscape: gentle slopes and broad crests of glacial moraines
Geologic material: loess
Slope shape: plane to slightly convex or concave
Slope steepness: 0 to 5%

Soil

Soil name: Pergelic Cryaquepts, silty (Chapter 6)
Soil profile:

Organic matter

Silt loam or very fine sandy loam

Permanently frozen:
silt loam or very fine sandy loam

Thickness of the organic mat: median 8 cm (range 5 to 18 cm); locally 0 cm on mudboils
Water table (Jul-Aug): none, but the thawed mineral soil is usually saturated
Depth to frozen soil (Jul-Aug): median 90 cm (range 53 to 128 cm)
Redoximorphic features: low-chroma mottles throughout the mineral soil; low-chroma matrix also often present in the upper 30 cm of mineral soil

Vegetation

Structure: (needleleaf dwarf tree scrub woodland)/low scrub/graminoids/lichens; () = stratum may be absent, / = "over"
Major species: *Picea mariana, Ledum palustre, Vaccinium uliginosum, Eriophorum vaginatum, Cladina spp.*
Vegetation site type: Mudboil tundra (Chapter 7)

Major Landscape-Forming Processes

Abrasion of plants by windblown snow - kills spruce foliage 0.5 to 1.5 m above the ground surface; hinders or prevents growth of spruce trees
Biochemical reduction
Cryoturbation and ice segregation - produces mudboils, earth hummocks, and mixed or broken

soil horizons
Herbivory - caribou graze lichens; microtine sign present
Soil organic-matter accumulation
Plant succession (Chapter 7)
Thermokarst - potential if surface is disturbed
Throughflow
Wildfire - spreads readily in dry lichens and graminoids

Component 2: Dry crests and upper slopes

Setting

Area covered by component: 15 to 40% of map unit
Position on the landscape: crests and upper slopes of glacial moraines
Geologic material: loess over glacial till
Slope shape: plane to convex
Slope steepness: 0 to 10%

Soil

Soil name: Cryochrepts, silty (Chapter 6)
Soil profile:

Organic matter

Silt loam, very fine sandy loam;
gravelly silt loam or loam

Very gravelly sandy loam

Thickness of the organic mat: median 6 cm (range 2 to 14 cm)
Water table (Jul-Aug): none within 150 cm of the suface
Depth to very gravelly material: median more than 150 cm (range 90 cm to more than 150 cm)
Redoximorphic features: low-chroma mottles beginning in the upper 0.8 m and extending downward; low-chroma matrix occasionally present below 1 m

Vegetation

Structure: needleleaf or mixed, woodland or open forest/(open tall scrub)/closed low scrub/lichens; () = stratum may be absent, / = "over"
Major species: *Picea mariana, Populus tremuloides, Betula glandulosa, Ledum plasutre, Vaccinium uliginosum, Cladina spp.*
Vegetation site type: Dry terraces and uplands (lichen woodland)(Chapter 7)

Major Landscape-Forming Processes

Biochemical reduction - occurs but weak due to good drainage
Herbivory - caribou graze lichens; microtine sign present
Soil organic-matter accumulation - occurs but limited by dryness
Plant succession (Chapter 7)
Wildfire - spreads readily in dry lichens and black spruce trees of this unit; dry organic mat

may be consumed entirely by a severe fire

Component 3: Tussock tundra

Setting

Area covered by component: 0 to 30% of map unit
Position on the landscape: gentle slopes and broad, gentle crests of glacial moraines
Geologic material: organic matter over loess
Slope shape: plane to weakly convex or concave
Slope steepness: 0 to 5%

Soil

Soil name: Cryaquepts (Chapter 6)
Soil profile:

Organic matter

Silt loam

Permanently frozen silt loam

Thickness of the organic mat: median 35 cm (range 24 to 38 cm)
Water table (Jul-Aug): median depth to water table 25 cm (range 17 to 30 cm)
Depth to frozen soil (Jul-Aug): 37 cm (range 30 to 64 cm)
Redoximorphic features: low-chroma matrix throughout the mineral soil

Vegetation

Structure: low scrub/graminoids; ()=stratum may be absent, /="over"
Major species: *Ledum palustre, Vaccinium spp., Eriophorum vaginatum, Sphagnum spp.*
Vegetation site type: Tussock tundra (Chapter 7)

Major Landscape-Forming Processes

Abrasion of plants by windblown snow - kills spruce foliage 0.5 to 1.5 m above the soil surface; hinders or prevents growth of spruce trees
Biochemical reduction
Cryoturbation and ice segregation
Herbivory - caribou probably graze graminoids
Soil organic-matter accumulation - produces tussocks
Thermokarst - potential if surface is disturbed
Throughflow - through organic surface layer
Wildfire - spreads readily in dry graminoids; moist lower portions of organic mat probably survives most fires

Component 4: Thermokarsting low areas

Setting

Area covered by component: 3 to 10% of map unit

Position on the landscape: depressions and flat areas on glacial moraines
Geologic material: organic matter over loess
Slope shape: plane to concave
Slope steepness: 0 to 2%

Soil
Soil name: Cryaquepts (Chapter 6)
Soil profile:

Organic matter

Silt loam

Permanently frozen silt loam

Thickness of the organic mat: median 20 cm (range 16 to 30 cm)
Water table or saturated soil (Jul-Aug): mineral soil is only locally saturated, because water drains into associated thermokarst pits
Depth to frozen soil (Jul-Aug): median 46 cm (range 44 to 50 cm) from the mineral soil surface
Redoximorphic features: low-chroma matrix throughout the mineral soil

Vegetation
Structure: needleleaf tree or dwarf tree scrub woodland/low scrub/graminoids/lichens; () = stratum may be absent, / = "over"
Major species: *Picea mariana, Ledum palustre, Vaccinium spp., Eriophorum spp., Cladina spp.*
Vegetation site type: Pit and mound depressions, tundra (Chapter 7)

Major Landscape-Forming Processes
Biochemical reduction
Cryoturbation and ice segregation - facilitates thermokarst
Soil organic-matter accumulation
Thermokarst - has produced approximately 1 m of subsidence
Wildfire - spreads readily in dry lichens, graminoids, and black spruce trees

Component 5: Small stream flood plains

Setting
Area covered by component: 5% of map unit
Position on the landscape: drainage channels on glacial moraines
Geologic material: alluvium
Slope shape: concave
Slope steepness: 0 to 5%

Soil

Soil profile:

Organic matter

Silt loam; or stratified
sand and silt

Very to extremely gravelly
loam, loamy sand, or sand

Thickness of the organic mat: median 6 cm (range 0 to 15 cm)

Water table (Jul-Aug): occasionally present within 50 cm of the surface, and the soil is usually saturated within 50 cm of the surface.

Depth to sand and gravel: median more than 50 cm (range 15 to more than 50 cm) from the mineral soil surface

Redoximorphic features: loamy material has low-chroma matrix

Vegetation

Structure: (tall scrub)/closed low scrub/(graminoids)/moss; () = stratum may be absent, / = "over"

Major species: *Salix spp., Vaccinium uliginosum, Calamagrostis canadensis, Drepanocladus spp., Sphagnum spp.*

Vegetation site type: Small stream flood plains on moraines (Chapter 7)

Major Landscape-Forming Processes

Biochemical reduction

Flooding and alluviation - frequent; prevents buildup of a thick surface organic layer

Icing - persistent icings form in some areas (see Fig. 2); icing is also likely elsewhere if natural flow is obstructed

Soil organic-matter accumulation

Throughflow

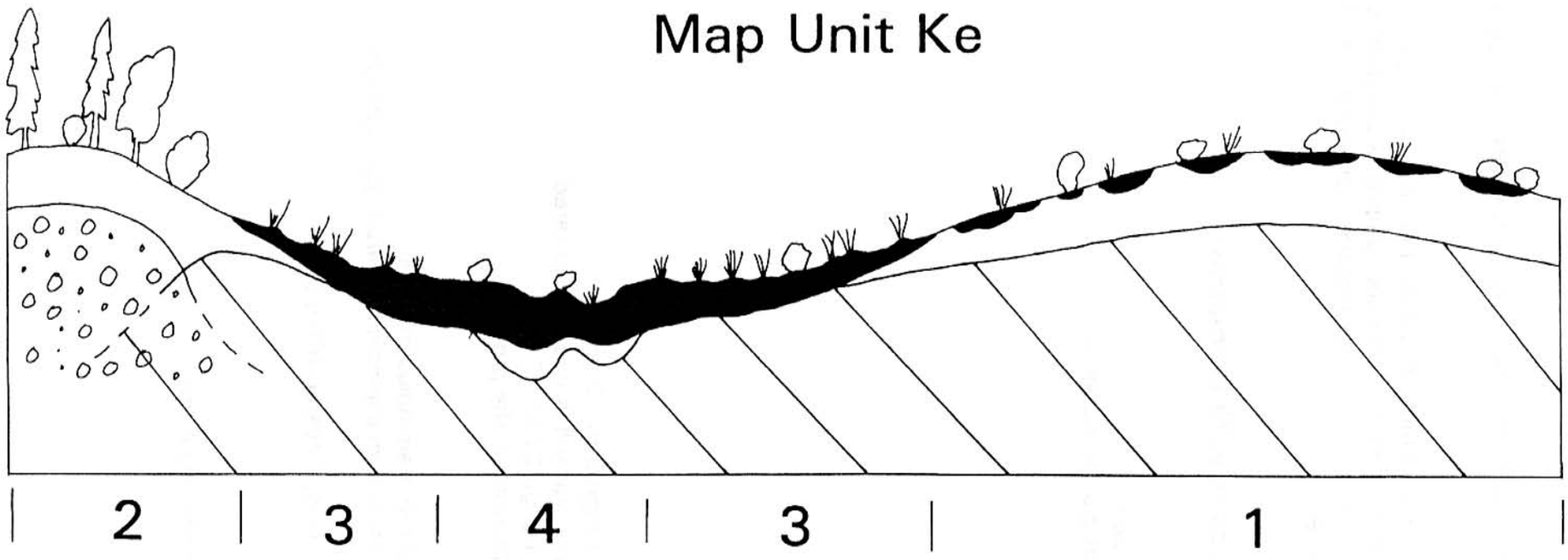
Minor Components

*Thermokarst pits with organic soil and water at the surface in component 4

*Sandy and gravelly soils on hill crests

*Steep slopes with dry soils along incised streams

*Forested gentle slopes with permafrost



Ke ***Kobuk moraines, ecotonal (lowland tundra-forest)***

1 Mudboil tundra
2 Dry crests and upper slopes
3 Tussock tundra
4 Thermokarsting low areas
5 Small stream floodplains

Organic matter

Loamy

Very to extremely gravelly

Permafrost

Fig. 11. Landscape diagram of map unit Ke.

Ko = Kobuk Moraines

(Nat.'l Coop Soil Survey name: Cryaquepts - Cryochrepts, silty - Cryochrepts, cool association, rolling)

Map unit setting: lowlands in the western third of the study area (Fig. 12). Kobuk moraines are the oldest moraines in the study area; as a result, morainal topography is completely obliterated and loess is at least 1.5 m thick over most of the moraine. Elevation: 107 to 366 m (350 to 1200 feet) above sea level.

Component 1: Gentle slopes with permafrost

Setting

Area covered by component: 10 to 40% of map unit
Position on the landscape: slopes and crests of glacial moraines
Geologic material: loess
Slope shape: convex to plane
Slope steepness: 0 to 5%

Soil

Soil name: Cryaquepts (Chapter 6)
Soil profile:

Organic matter

Silt loam

Permanently frozen
silt loam

Thickness of the organic mat: median 14 cm (range 8 to 20 cm)
Water table (Jul-Aug): none, but the thawed mineral soil is usually saturated
Depth to frozen soil (Jul-Aug): median 42 cm (range 27 to 76 cm)
Redoximorphic features: low-chroma matrix throughout the profile

Vegetation

Vegetation: needleleaf open forest/open low scrub/graminoids/mosses
Major species: *Picea mariana, Ledum palustre, Vaccinium uliginosum, Carex spp., Sphagnum spp.*
Vegetation site type: Frozen moraines and terraces, forested (Chapter 7)

Major Landscape-Forming Processes

Biochemical reduction
Cryoturbation and ice segregation - produces earth hummocks
Herbivory - caribou occasionally graze lichens
Soil organic-matter accumulation
Plant succession (Chapter 7)
Thermokarst - potential if surface is disturbed

Throughflow - through the organic horizon
Wildfire - spreads readily in black spruce forest; in some areas the organic surface layer may be consumed entirely if the fire is severe, producing component 4

Component 2: Striped colluvial slopes with permafrost

Setting

Area covered by component: 20 to 30% of map unit
Position on the landscape: slopes of glacial moraines
Slope shape: concave or plane
Geologic material: organic matter over colluviated loess or over colluviated loess and glacial outwash
Slope steepness: 5 to 15%

Soil

Soil name: Cryaquepts (Chapter 6)
Soil profile:

Organic matter

Silt loam, loam, sandy loam,

Permanently frozen silt loam, loam, or sandy loam

Thickness of the organic mat: median 18 cm (range 10 to 25 cm)
Water table (Jul-Aug): usually none, but the thawed mineral soil is occasionally saturated
Depth to frozen soil (Jul-Aug): median 24 cm (range 20 to 34 cm)
Redoximorphic features: low-chroma matrix throughout the profile

Vegetation

Structure: needleleaf open forest/open tall scrub/open low scrub/graminoids/mosses; () = stratum may be absent, / = "over"
Major species: *Picea mariana, Alnus crispa, Ledum palustre, Vaccinium uliginosum, Carex spp., Sphagnum spp.*
Vegetation site type: Striped colluvial slopes (Chapter 7)

Major Landscape-Forming Processes

Biochemical reduction
Cryoturbation and ice segregation
Herbivory - microtine sign common
Icing - possible if natural drainage is blocked
Soil organic-matter accumulation
Plant succession (Chapter 7)
Thermokarst - potential if surface is disturbed
Throughflow - mainly through the organic horizon; produces striped pattern of vegetation (visible on aerial photographs)
Wildfire - appears to be light on this component; moist lower portion of the organic mat

usually survives fires

Component 3: Dry crests and upper slopes

Setting

Area covered by component: 5 to 50% of map unit
Position on the landscape: crests and upper slopes of glacial moraines
Geologic material: loess over glacial outwash
Slope shape: convex or plane
Slope steepness: 0 to 6%

Soil

Soil name: Cryochrepts, silty (Chapter 6)
Soil profile:

Organic matter

Silt loam

Sand and gravel

Thickness of the organic mat: median 8 cm (range 3 to 18 cm)
Water table (Jul-Aug): none within 150 cm of the surface
Depth to frozen soil (Jul-Aug): median 120 cm (range 50 to more than 150 cm); may be absent
Depth to sand and gravel: median more than 150 cm (range 100 cm to more than 150 cm) from the mineral soil surface
Redoximorphic features: low-chroma mottles occasionally present throughout the profile

Vegetation

Structure: needleleaf or mixed open forest/low scrub/(lichens); () = stratum may be absent, / = "over"
Major species: *Picea mariana, Populus tremuloides, Ledum palustre, Vaccinium uliginosum, Cladina spp.*
Vegetation site type: Dry terraces and uplands (lichen woodland)(Chapter 7)

Major Landscape-Forming Processes

Biochemical reduction - occurs but weak due to rather dry conditions
Herbivory - caribou graze lichens
Soil organic-matter accumulation - occurs but is limited by dryness
Plant succession (Chapter 7)
Wildfire - spreads readily in black spruce forest; organic surface layer is often dry and consumed almost entirely by severe fires

Component 4: Gentle slopes with post-burn thaw

Setting

Area covered by component: 0 to 30% of map unit
Position on the landscape: crests and upper slopes of glacial moraines, in areas burned within the past 100 years
Geologic material: loess
Slope shape: convex or plane
Slope steepness: 0 to 12%

Soil

Soil name: Cryochrepts, cool (Chapter 6)
Soil profile:

Organic matter

Silt loam

Thickness of the organic mat: median 9 cm (range 7 to 12 cm)
Water table (Jul-Aug): none within 150 cm of the surface
Depth to frozen soil (Jul-Aug): median more than 150 (range 100 to more than 150 cm) from the mineral soil surface
Redoximorphic features: low-chroma mottles present throughout the profile; low-chroma matrix sometimes present below 0.5 m

Vegetation

Structure: needleleaf or mixed, open forest or woodland/(open tall scrub)/open low scrub/moss or lichens; () = stratum may be absent, / = "over"
Major species: *Picea mariana, Populus tremuloides, Betula glandulosa, Vaccinium uliginosum, Ledum plaustre, Polytrichum spp., Cladonia spp.*
Vegetation site type: Burn thaw-susceptible terraces and uplands (Chapter 7)

Major Landscape-Forming Processes

Biochemical reduction - temporarily less active due to lowering of the permafrost table after burns
Cryoturbation and ice segregation - temporarily less active due to lowering of the permafrost table after burns
Herbivory - microtine sign common
Soil organic-matter accumulation
Plant succession (Chapter 7)
Throughflow - through surface organic mat
Wildfire - spreads readily in old black spruce forest; post-burn deciduous vegetation is less flammable; component is produced by severe burn of component 1.

Component 5: Wet, nearly level areas with peat

Setting

Area covered by component: 10 to 20% of map unit

Position on the landscape: wide, flat crests of glacial moraines
Geologic material: organic matter over loess
Slope shape: concave or plane
Slope steepness: 0 to 2%

Soil

Soil name: Cryaquepts (Chapter 6)
Soil profile:

Organic matter

Silt loam

Permanently frozen silt loam

Thickness of the organic mat: median 34 cm (range 20 to more than 60 cm); locally thinner due to cryoturbation
Water table (Jul-Aug): occasionally present near the mineral soil surface, and the thawed mineral soil is usually saturated
Depth to frozen soil (Jul-Aug): median 43 cm (range 30 to 60 cm); locally deeper under mudboils
Redoximorphic features: low-chroma matrix throughout the mineral soil

Vegetation

Structure: needleleaf woodland/open low scrub/graminoids/mosses; () = stratum may be absent, / = "over"
Major species: *Picea mariana, Ledum palustre, Vaccinium uliginosum, Carex spp., Eriophorum vaginatum, Sphagnum spp.*
Vegetation site type: Wet, nearly level areas with peat on moraines (Chapter 7)

Major Landscape-Forming Processes

Biochemical reduction
Cryoturbation and ice segregation - produces earth hummocks and mudboils
Herbivory - caribou occasionally graze lichens; microtine sign common
Soil organic-matter accumulation
Plant succession (Chapter 7)
Thermokarst - results in 0.5 to 1 m of subsidence
Wildfire - burns are apparently light on this component; moist lower poriton of the organic mat usually survives fires

Component 6: Small stream flood plains

Setting

Area covered by component: 2 to 5% of map unit
Position on the landscape: channels on glacial moraines
Geologic material: alluvium
Slope shape: concave
Slope steepness: 1 to 10%

Soil

Soil profile:

Organic matter

Silt loam, or
stratified sand and silt

Very or extremely gravelly
loam, sandy loam, or sand

Thickness of the organic mat: median 6 cm (range 0 to 15 cm)

Water table (Jul-Aug): occasionally present within 50 cm of the surface, and the soil is usually saturated within 50 cm of the surface

Depth to sand and gravel: median more than 50 cm (range 15 to more than 50 cm) from the mineral soil surface

Redoximorphic features: low-chroma matrix throughout the profile

Vegetation

Structure: (tall scrub)/closed low scrub/(graminoids)/moss; ()=stratum may be absent, /="over"

Major species: *Salix spp., Vaccinium uliginosum, Calamagrostis canadensis, Drepanocladus spp.*

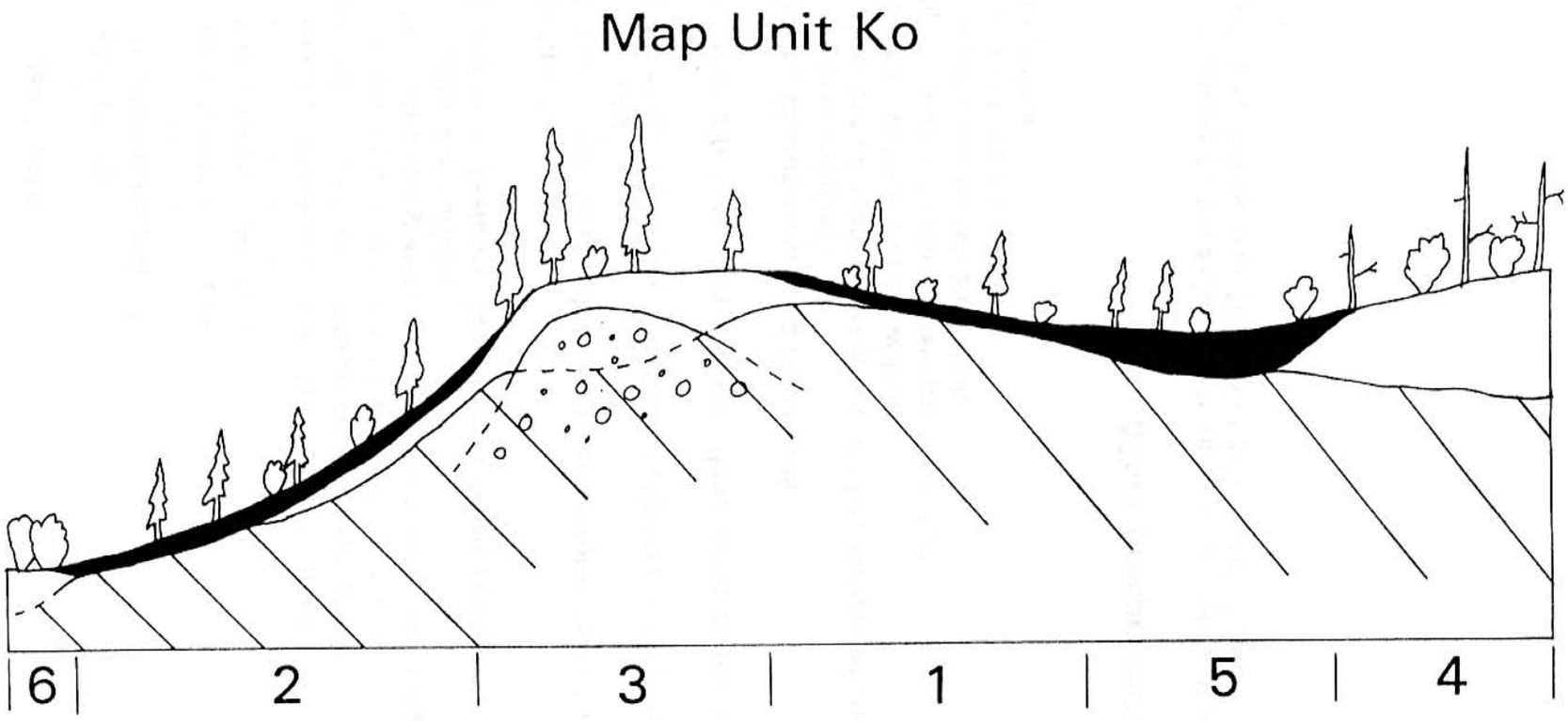
Vegetation site type: Small stream flood plains on moraines (Chapter 7)

Major Landscape-Forming Processes

Biochemical reduction
Flooding and alluviation - frequent; hinders buildup of surface organic mat
Herbivory - moose browse willows
Icing - probable if natural drainage is blocked
Soil organic-matter accumulation
Plant succession (Chapter 7)
Throughflow

Minor Components

*Escarpments to the Kobuk River valley with slopes of more than 15%
*Hilltops with less than 100 cm of silty material over sand and gravel



Ko *Kobuk moraines*

1 Gentle slopes with permafrost
2 Striped colluvial slopes with permafrost
3 Dry crests and upper slopes
4 Gentle slopes with post-burn thaw
5 Wet, nearly level areas with peat
6 Small stream floodplains

Organic matter

Loamy

Very to extremely gravelly

Permafrost

Fig. 12. Landscape diagram of map unit Ko.

Kw = Kobuk Moraines, Wet

(Nat.'l Coop Soil Survey name: Cryaquepts - Cryochrepts, shallow association, rolling)

Map unit setting: lowlands in the southern part of the study area (Fig. 13). Kobuk moraines are the oldest moraines in the study area; as a result, morainal topography is obliterated and loess is at least 0.5 m thick (probably more than 1 m) over most of the moraine. Elevation: 183 to 259 m (600 to 850 feet) above sea level.

Component 1: Gentle slopes (tussocks)

Setting

Area covered by component: 60% of map unit
Position on the landscape: gentle slopes of glacial moraines
Geologic material: organic matter over loess
Slope shape: plane
Slope steepness: 2 to 5%

Soil

Soil name: Cryaquepts (Chapter 6)
Soil profile:

Organic matter

Silt loam

Permanently frozen
silt loam

Thickness of the organic mat: median 30 cm (range 15 to 45 cm)
Water table (Jul-Aug): occasionally present near the mineral soil surface, and the thawed mineral soil is usually sataurated
Depth to frozen soil (Jul-Aug): median 45 (range 45 to 65 cm) from the mineral soil surface
Redoximorphic features: low-chroma matrix throughout the mineral soil

Vegetation

Structure: dwarf tree scrub woodland/closed low scrub/graminoids/mosses; () = stratum may be absent, / = "over"
Major species: *Picea mariana, Betula glandulosa, Ledum palustre, Vaccinium uliginosum, Eriphorum vaginatum, Sphagnum spp.*
Vegetation site type: Tussock wetland (Chapter 7)

Major Landscape-Forming Processes

Biochemical reduction
Cryoturbation and ice segregation - facilitates thermokarst
Icing - likely in small stream courses if natural drainage is blocked
Soil organic-matter accumulation
Plant succession (Chapter 7)

Thermokarst - produces component 4 from this component; 1 to 2 m of subsidence observed
Throughflow - through the surface organic mat
Wildfire - spreads readily in dry graminoids; moist lower portion of the organic mat usually survives fires

Component 2: Gentle to moderate slopes (forest)

Setting

Area covered by component: 20 to 25% of map unit
Position on the landscape: slopes of glacial moraines
Geologic material: organic matter over loess or colluviated loess
Slope shape: concave to plane
Slope steepness: 2 to 12%

Soil

Soil name: Cryaquepts (Chapter 6)
Soil profile:

Organic matter

Loam or silt loam

Permanently frozen:
loam or silt loam

Thickness of the organic mat: median 35 cm (range 16 to 45 cm)
Water table (Jul-Aug): not observed, but the thawed mineral soil is occasionally saturated
Depth to frozen soil (Jul-Aug): median 41 cm (range 32 to 66 cm)
Redoximorphic features: low-chroma matrix throughout the mineral soil

Vegetation

Structure: needleleaf woodland or open dwarf tree scrub/closed low scrub/moss; () = stratum may be absent, / = "over"
Major species: *Picea mariana, Ledum palustre, Vaccinium uliginosum, Sphagnum spp.*
Vegetation site type: Frozen moraines and terraces, forested (Chapter 7)

Major Landscape-Forming Processes

Biochemical reduction
Cryoturbation and ice segregation
Herbivory - microtine use likely
Soil organic-matter accumulation
Plant succession (Chapter 7)
Thermokarst - produce component 4 from this component; 1 to 2 m of subsidence observed
Throughflow - through surface organic mat
Wildfire - spreads readily in black spruce forest; moist lower portion of the organic mat usually survives fires

Component 3: Dry knobs

Setting

Area covered by component: 10 to 15% of map unit
Position on the landscape: shoulders and crests of small hills on glacial moraines
Geologic material: loess over glacial outwash
Slope shape: convex
Slope steepness: 0 to 10%

Soil

Soil name: Cryochrepts, shallow (Chapter 6)
Soil profile:

Organic matter

Fine sandy loam, loam,
silt loam

Sand and gravel

Thickness of the organic mat: median 2 cm (range 0 to 4 cm)
Water table (Jul-Aug): none within 150 cm of the surface
Depth to sand and gravel: median 35 cm (range 10 to 60 cm) from the mineral soil surface
Redoximorphic features: low-chroma mottles occasionally present in loamy material

Vegetation

Structure: open needleleaf, mixed, or deciduous forest/low scrub/lichens; () = stratum may be absent, / = "over"
Major species: *Picea mariana, Populus tremuloides, Ledum palustre, Vaccinium uliginosum, Cladina spp.*
Vegetation site type: Dry terraces and uplands (lichen woodland)(Chapter 7)

Major Landscape-Forming Processes

Biochemical reduction - occurs but weak due to good drainage
Soil organic-matter accumulation - occurs but restricted by dryness
Plant succession (Chapter 7)
Wildfire - spreads readily in lichen-rich black spruce forest; post-fire vegetation is less flammable. Organic surface layer can be consumed almost entirely by severe fires.

Component 4: Thermokarst depressions

Setting

Area covered by component: 3 to 5% of map unit
Position on the landscape: depressions on glacial moraines
Geologic material: organic matter over loess
Slope shape: plane
Slope steepness: 0 to 1%

Soil

Soil name: Histosols, ponded (Chapter 6)

Soil profile:

Slightly decomposed
Organic matter

Silt loam

Thickness of the organic mat: approximately 1 m

Water table (Jul-Aug): at the surface

Redoximorphic features: mineral soil (where observed) has low-chroma matrix

Vegetation

Structure: graminoids/moss; () = stratum may be absent, / = "over"

Major species: *Carex spp., Sphagnum spp.*

Vegetation site type: Thermokarst depressions (Chapter 7)

Major Landscape-Forming Processes

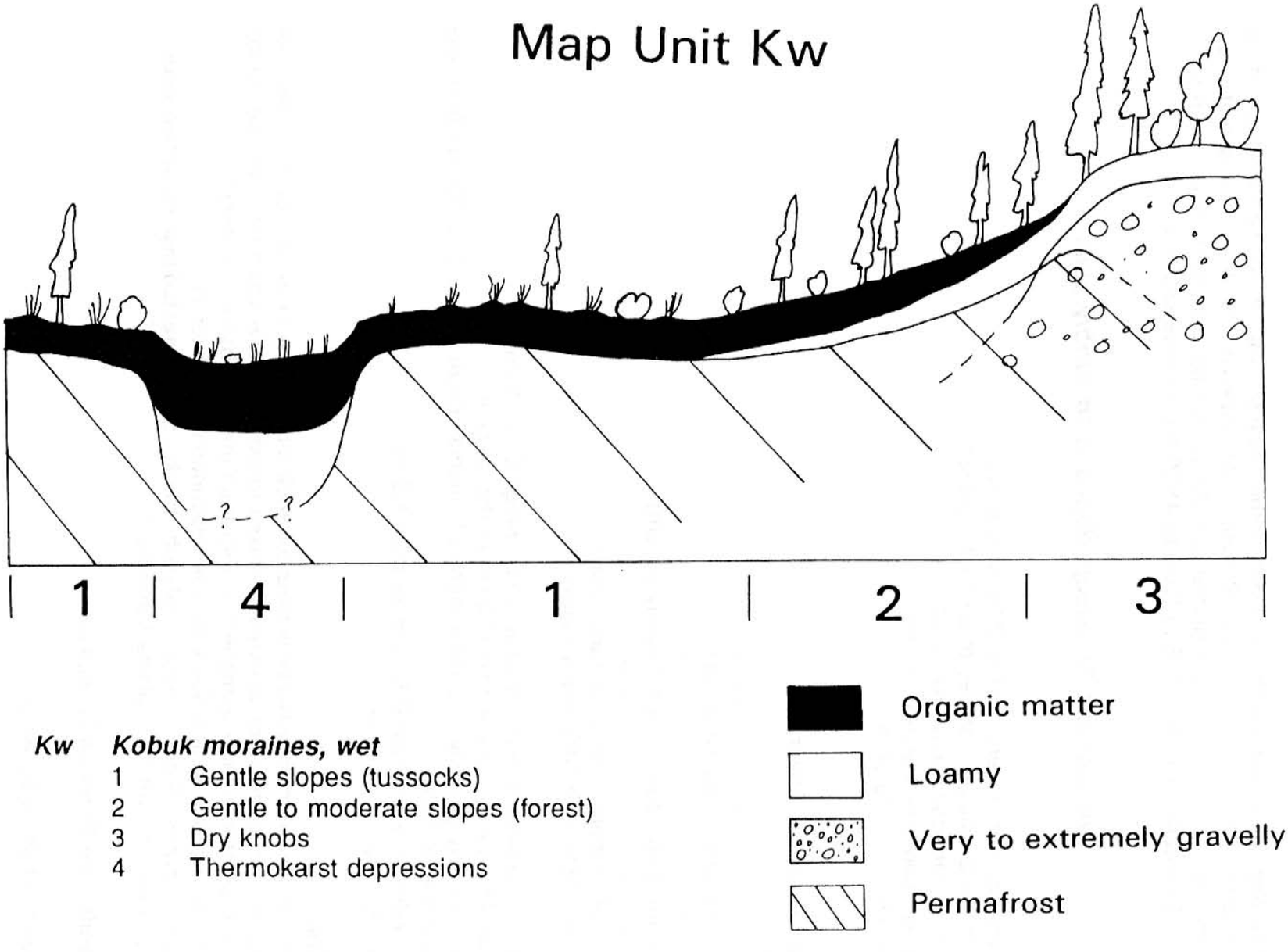
Biochemical reduction

Soil organic-matter accumulation

Thermokarst - produces this component from components 1 and 2; 1 to 2 m of subsidence observed

Minor Components

*Flood plains of small streams



Kw ***Kobuk moraines, wet***

1 Gentle slopes (tussocks)
2 Gentle to moderate slopes (forest)
3 Dry knobs
4 Thermokarst depressions

Fig. 13. Landscape diagram of map unit Kw.

Mh = High Mountains

(Nat.'l Coop Soil Survey Name: Orthents - Rock Outcrops Association)

Map unit setting: mountains with steep slopes and sharp summits in the northern part of the study area (the Anguyuchan and Schwatka Mountains). Valleys in this unit were glaciated during all Pleistocene glacial periods, producing U-shaped valleys with steep sides. Elevation: 152 to 1408 m (500 to 4620 feet) above sea level.

Component 1: Steep slopes with rubbly soils

Setting

Area covered by component: 70 to 90% of map unit
Position on the landscape: slopes of bedrock uplands
Geologic material: colluvium, glacial till
Slope shape: concave, convex, or plane
Slope steepness: 25 to 70%

Soil

Soil name: Orthents (Chapter 6)
Soil profile:

Organic matter (may be absent)

Silt loam, loam, sandy loam (usually absent)

Extremely cobbly or gravelly sandy loam;
or rock rubble with little loamy matrix

Thickness of the organic mat: median 6 cm (range 0 to 15 cm)
Water table (Jul-Aug): none within 150 cm of the surface
Depth to extremely gravelly or cobbly material: median 0 cm (range 0 to 10 cm) from the mineral soil surface
Depth to bedrock: estimated 0.5 to more than 1.5 m
Redoximorphic features: none

Vegetation

Structure: unvegetated or crustose lichens (on rock rubble); low or dwarf scrub/lichens; tall scrub/low scrub (at lower elevations); mixed forest/tall or low scrub (at lower elevations where protected from avalanches); () = stratum may be absent, / = "over"
Major species: see the vegetation site type descriptions (Chapter 7)
Vegetation site types: Alpine tundra; Avalanche tracks; Steep forested high mountain slopes; Alpine small stream flood plains (Chapter 7)

Major Landscape-Forming Processes

Creep
Redistribution of snow by wind
Rockfall

Snow avalanches

Component 2: Rock outcrops

Setting

Area covered by component: 10 to 30% of map unit
Position on the landscape: slopes and crests of bedrock uplands
Geologic material: bedrock
Slope shape: convex to plane
Slope steepness: 0% to vertical

Vegetation

Structure: mostly crustose lichens or unvegetated

Major Landscape-Forming Processes

Snow avalanches
Rockfall
Wind redeposition of snow

Minor Components

*Flood plains of small streams
*Permanent snowbanks
*Wet soils at bases of slopes

MI = Low Mountains

(Nat.'l Coop Soil Survey Name: Cryochrepts, bedrock substratum - Typic Cryochrepts, loamy-skeletal association, very hilly)

Map unit setting: mountains with rounded summits and moderately steep slopes (Akoliak, Lockwood, Norutak, Nilunorat, and Helpmejack Hills; Fig. 14). Mostly unglaciated. Elevation: 183 to 1036 m (600 to 3400 feet) above sea level.

Component 1: Dry crests and upper slopes (forest and scrub)

Setting

Area covered by component: 25 to 50% of map unit
Position on the landscape: crests, shoulders, and upper slopes of bedrock uplands (near treeline or below)
Geologic material: colluvium, weathered bedrock
Slope shape: convex to plane
Slope steepness: 0 to 50%

Soil

Soil name: Cryochrepts, bedrock substratum (Chapter 6)
Soil profile:

Organic matter

Silt loam, loam, sandy loam;
gravelly silt loam, loam, sandy loam

Very to extremely gravelly or cobbly
silt loam, loam, sandy loam

Thickness of the organic mat: median 3 cm (range 0 to 8 cm)
Water table (Jul-Aug): none within 150 cm of the surface
Depth to frozen soil (Jul-Aug): unknown
Depth to very or extremely gravelly material: median 0 cm (range 0 to 60 cm) from the mineral soil surface
Depth to bedrock: estimated 0.5 to 1.5 m
Redoximorphic features: none

Vegetation

Structure: (needleleaf or mixed, open forest or woodland)/(open tall scrub)/low scrub/(lichens); () = stratum may be absent, / = "over"
Major Species: *Picea glauca, Picea mariana, Betula papyrifera, Alnus crispa, Betula glandulosa, Ledum palustre, Vaccinium uliginosum, Caldina spp.*
Vegetation site type: Dry crests and upper slopes of low mountains (forest and scrub)(Chapter 7)

Major Landscape-Forming Processes

Creep
Herbivory - caribou graze lichens
Soil organic-matter accumulation - occurs but is inhibited by dryness
Groundwater recharge - likely if taliks (permafrost-free areas) are present
Throughflow

Component 2: Midslopes, unfrozen (forested)

Setting

Area covered by component: 20 to 40% of map unit
Position on the landscape: slopes of bedrock uplands (usually south- or west-facing)
Geologic material: colluvium
Slope shape: plane
Slope steepness: 15 to 55%

Soil

Soil name: Typic Cryochrepts, loamy-skeletal (Chapter 6)
Soil profile:

Organic matter

Loam, silt loam; gravelly
silt loam or loam

Very to extremely gravelly or cobbly
silt loam, loam, or sandy loam

Thickness of the organic mat: median 11 cm (range 5 to 22 cm)
Water table (Jul-Aug): none within 150 cm of the surface
Depth to very or extremely gravelly material: median 3 cm (range 0 to 30 cm) from the mineral soil surface
Depth to bedrock: estimated more than 1.5 m
Redoximorphic features: none

Vegetation

Structure: needleleaf woodland or open mixed forest/tall scrub/low scrub/moss; () = stratum may be absent, / = "over"
Major Species: *Picea mariana, Betula papyrifera, Alnus crispa, Spiraea beauverdiana, Vaccinium uliginosum, Hylocomium splendens*
Vegetation site type: Low mountain midslopes, unfrozen (forest)(Chapter 7)

Major Landscape-Forming Processes

Creep
Soil organic-matter accumulation
Throughflow - in the organic mat

Component 3: Dry crests and upper slopes (tundra)

Setting

Area covered by component: 0 to 35% of map unit
Position on the landscape: crests and shoulders of bedrock uplands, above treeline
Geologic material: weathered bedrock
Slope shape: convex
Slope steepness: 0 to 15%

Soil

Soil name: Cryochrepts, bedrock substratum (Chapter 6)
Soil profile:

Very to extremely gravelly or cobbly
sandy loam, loam, or silt loam

Thickness of the organic mat: median 0 cm (range 0 to 10 cm)
Depth to frozen soil (Jul-Aug): unknown
Water table (Jul-Aug): none within 150 cm of the surface
Depth to bedrock: estimated 0.5 to 1.0 m
Redoximorphic features: none

Vegetation

Structure: open low or dwarf scrub/lichens; () = stratum may be absent, / = "over"
Major species: *Betula glandulosa, Ledum palustre, Loiseleuria procumbens, Cladina spp.*
Vegetation site type: Alpine tundra (Chapter 7)

Major Landscape-Forming Processes

Abrasion of plants by windblown snow
Creep
Cryoturbation - has produced sorted circles and nets, and mudboils
Soil organic-matter accumulation - occurs but is inhibited by dryness
Solifluction

Component 4: Steep north slopes with permafrost

Setting

Area covered by component: 5 to 15% of map unit
Position on the landscape: north-facing slopes of bedrock uplands
Geologic material: organic matter over colluvium
Slope shape: plane
Slope steepness: 25 to 65%

Soil

Soil profile:

Organic matter

Silt loam

Very to extremely gravelly or cobbly loam

Permanently frozen: very to extremely gravelly or cobbly loam

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Thickness of the organic mat: median 22 cm (range 9 to 30 cm)
Water table (Jul-Aug): water table occasionally present in the upper 30 cm of mineral soil
Depth to frozen soil (Jul-Aug): median 54 cm (range 38 to 70 cm)
Depth to very or extremely gravelly material: median 0 cm (range 0 to 20 cm) from the mineral soil surface
Depth to bedrock: estimated 0.5 to 1.5 m
Redoximorphic features: silt loam commonly has low-chroma matrix

Vegetation

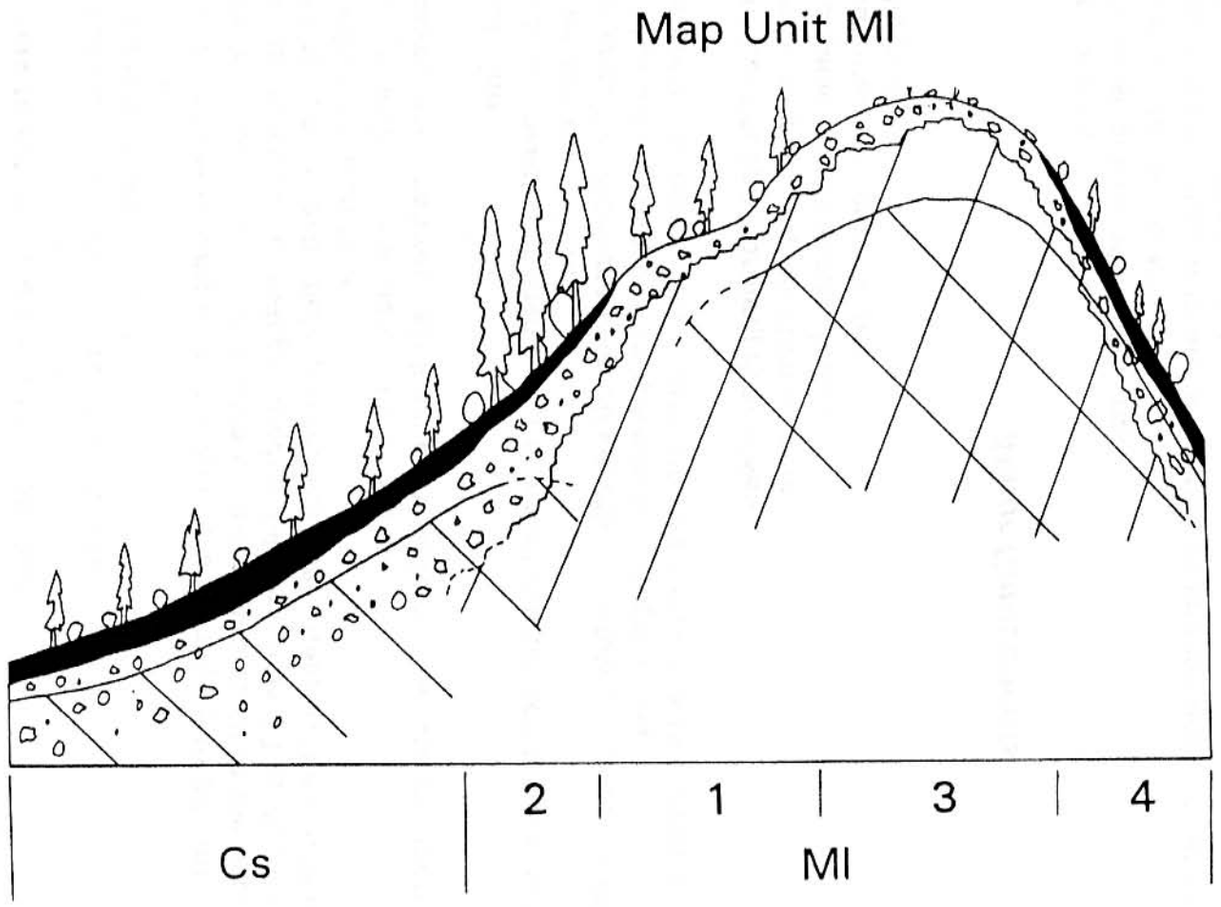
Structure: (needleleaf open forest or woodland)/tall scrub/low scrub/moss; () = stratum may be absent, / = "over"
Major species: *Picea mariana, Alnus crispa, Betula glandulosa, Ledum palustre, Vaccinium uliginosum, Hylocomium splendens, Sphagnum spp.*
Vegetation site type: Steep north mountain slopes with permafrost (Chapter 7)

Major Landscape-Forming Processes

Abrasion of plants by windblown snow
Soil organic-matter accumulation
Throughflow - in organic mat
Solifluction

Minor Components

*Rock outcrops
*Steeper slopes on all components
*Areas of glacial moraine
*South-facing slopes with graminoid-rich vegetation above treeline
*Wet areas in component 3



MI ***Low Mountains***

1 Dry crests and upper slopes (forest and scrub)
2 Midslopes, unfrozen (forest)
3 Dry crests and upper slopes (tundra)
4 Steep north slopes with permafrost

Organic matter
Very to extremely gravelly
Bedrock
Permafrost

Fig. 14. Landscape diagram of map unit MI.

Nu = Nutuvukti Moraines

(Nat.'l Coop Soil Survey Name: Cryochrepts, shallow, very hilly)

Map unit setting: steep, gravelly glacial moraine north of Nutuvukti Lake. Glaciers deposited the moraine at the same time as the Walker Lake moraine; this glaciaton is the youngest in the study area, hence moraine slopes are still rather steep and little loess is present. Elevation: 213 to 274 m (700 to 900 feet) above sea level.

Note: north of 67 deg 05 min N, an area that was not sampled, this unit may have bedrock near the surface

Component 1: Dry crests and slopes

Setting

Area covered by component: 80 to 90% of map unit
Position on the landscape: slopes and crests of glacial moraines
Geologic material: glacial till
Slope steepness: 0 to 35%
Slope shape: convex, plane, or concave

Soil

Soil name: Cryochrepts, shallow (Chapter 6)
Soil profile:

Organic matter

Gravelly sandy loam or loam

Very gravelly loamy sand

Thickness of the organic mat: median 0 cm (range 0 to 3 cm)
Depth to very gravelly material: median 35 cm (range 0 to 50 cm)
Water table (Jul-Aug): none within 150 cm of the surface
Redoximorphic features: low-chroma mottles rarely present in the upper 50 cm

Vegetation

Structure: needleleaf woodland/open tall scrub/(low scrub)/moss or lichens; () = stratum may be absent, / = "over"
Major species: *Picea mariana, Betula glandulosa, Vaccinium uliginosum, Polytrichum spp., Cladina spp.*
Vegetation site type: Dry terraces and uplands (lichen woodland)(Chapter 7)

Major Landscape-Forming Processes

Groundwater recharge - probably occurs mainly in the spring when water ponds in depressions and then infiltrates; this water feeds a large fen between the moraine and Nutuvukti Lake
Soil organic-matter accumulation - occurs, but limited by dryness and fires

Podzolization - occurs locally in moist depressions due to greater leaching there
Wildfire - spreads readily in dry spruce forest; the thin, dry organic horizons are consumed almost entirely by most fires

Minor Components

*Depressions with wetter soils
*Flood plains of small streams
*Bedrock outcrops

Td = Dry River Terraces

(Nat.'l Coop Soil Survey Name: Cryochrepts, shallow)

Map unit setting: nearly level surfaces near the Kobuk River, above the reach of floods. Elevation: 122 to 259 m (400 to 850 feet) above sea level.

Component 1: Level areas with shallow soils over gravel

Setting

Area covered by component: 80 to 95% of map unit
Position on the landscape: river terraces
Geologic material: alluvium, or loess over alluvium
Slope steepness: 0 to 2%
Slope shape: plane

Soil

Soil name: Cryochrepts, shallow (Chapter 6)
Soil profile:

Organic matter

Stratified silt and sand

Sand and gravel

Thickness of the organic mat: median 0 cm (range 0 to 5 cm)
Depth to sand and gravel: median 32 cm (range 20 to 90 cm) from the mineral soil surface
Water table (Jul-Aug): none within 150 cm of the surface
Redoximorphic features: low-chroma mottles occasionally present in the stratified silt and sand

Vegetation

Structure: needleleaf woodland or dwarf tree scrub/open tall scrub/low scrub/lichens and moss; () = stratum may be absent, / = "over"
Major Species: *Picea mariana, Betula glandulosa, Ledum palustre, Vaccinium uliginosum, Polytrichum spp., Cladina spp.*
Vegetation site type: Dry terraces and uplands (lichen woodland) (Chapter 7)

Major Landscape-Forming Processes

Flooding and alluviation (past) - this map unit was originally a flood plain, but rivers have downcut so that now it is more than 3 m above the mean summer waterline and probably beyond the reach of floods.
Groundwater recharge - presumed to occur in depressions, mainly in the spring.
Herbivory - caribou graze lichens.
Soil organic-matter accumulation - is limited by dryness of soils
Plant succession (Chapter 7)
Podzolization - occurs locally, usually where the surface soil is sandy

Wildfire - spreads readily in dry spruce forest; organic surface layers are dry and consumed almost entirely by most fires

Minor Components

*wetter soils in depressions (old channel scars) and in areas transitional to map unit Tw

To = Older River Terraces

(Nat.'l Coop Soil Survey Name: Cryochrepts, cool - Cryaquepts, gravelly substratum association)

Map unit setting: nearly level surfaces north of the Kobuk River, now above the reach of floods. These terraces are higher, older, and covered with more loess (0.5 to over 1.5 m) than other terraces in the study area. A distinct east-west fault trace is visible on this unit from aerial photographs, indicating movement on the fault since deposition of the terrace alluvium. Elevation: 107 to 152 m (350 to 500 feet) above sea level.

Component 1: Areas of moist soils with post-burn thaw

Setting

Area covered by component: 40 to 60% of map unit
Position on the landscape: alluvial terraces
Geologic material: loess over alluvium
Slope steepness: 0 to 3%
Slope shape: plane

Soil

Soil name: Cryochrepts, cool (Chapter 6)
Soil profile:

Organic matter

Silt loam, or stratified
silt loam and fine sand

Sand and gravel

Thickness of the organic mat: median 2 cm (range 0 to 10 cm)
Depth to sand and gravel: median 140 cm (range 50 to more than 150 cm) from the mineral soil surface
Water table (Jul-Aug): none within 150 cm of the surface
Redoximorphic features: low-chroma mottles sometimes present in the loamy horizons

Vegetation

Structure: needleleaf or mixed woodland/low scrub/mosses and lichens; () = stratum may be absent, / = "over"
Major species: *Picea mariana, Populus tremuloides, Ledum palustre, Vaccinium uliginosum, Polytrichum spp., Cladonia spp.*
Vegetation site type: Burn thaw-susceptible terraces and uplands (Chapter 7)

Major Landscape-Forming Processes

Biochemical reduction - occurs but weak due to dryness
Ice segregation and cryoturbation - temporarily less active until succession raises the permafrost table; has produced earth hummocks

Soil organic-matter accumulation
Plant succession (Chapter 7) - facilitates the rise of the permafrost table
Wildfire - deciduous post-burn vegetation is less flammable than later successional stage vegetation of this component.

Component 2: Areas of wet soils with permafrost

Setting

Area covered by component: 30 to 40% of map unit
Position on the landscape: alluvial terraces
Geologic material: organic matter over loess
Slope steepness: 0 to 3%
Slope shape: plane

Soil

Soil name: Cryaquepts, gravelly substratum (Chapter 6)
Soil profile:

Organic matter

Silt loam

Permanently
frozen silt loam

Thickness of the organic mat: median 15 cm (range 8 to 40 cm)
Depth to frozen soil (Jul-Aug): median 46 cm (range 40 to 52 cm)
Water table (Jul-Aug): occasionally present near the mineral soil surface, and the thawed mineral soil is usually saturated
Redoximorphic features: low-chroma matrix throughout the soil profile

Vegetation

Structure: needleleaf woodland or dwarf tree scrub/open low scrub/mosses and lichens; () = stratum may be absent, / = "over"
Major species: *Picea mariana, Ledum palustre, Vaccinium uliginosum, Sphagnum spp., Cladina spp.*
Vegetation site type: Frozen moraines and terraces, forested (Chapter 7)

Major Landscape-Forming Processes

Biochemical reduction
Ice segregation and cryoturbation - has produced earth hummocks
Soil organic-matter accumulation
Plant succession (Chapter 7)
Wildfire - spreads readily in black spruce forest; moist lower organic horizons likely to survive fires

Minor Components

*Areas with thinner loamy soil over sand and gravel
*Areas with properties transitional between the two major components
*Flood plains of small streams
*Depressions with ephemeral ponds and no permafrost

Tw = Wet River Terraces

(Nat.'l Coop Soil Survey Name: Cryaquepts, gravelly substratum, Histosols, ponded, and Histosols)

Map unit setting: nearly level surfaces in river valleys that are wet due to groundwater discharge and runoff from surrounding uplands. Elevation: 91 to 244 m (300 to 800 feet) above sea level.

Component 1: Frozen terraces, mesotrophic

Setting

Area covered by component: 20 to 95% of map unit
Position on the landscape: stream terraces
Geologic material: organic matter over alluvium
Slope steepness: 0 to 2%
Slope shape: plane

Soil

Soil name: Cryaquepts, gravelly substratum (Chapter 6)
Soil profile:

Organic matter

Silt loam

Permanently frozen: silt loam
or stratified silt and sand

Thickness of the organic mat: median 28 cm (range 10 to 35 cm)
Depth to frozen soil (Jul-Aug): median 50 cm (range 40 to 74 cm)
Water table (Jul-Aug): often present within 50 cm of the surface, and the thawed soil is usually saturated
Redoximorphic features: low-chroma matrix throughout the mineral soil

Vegetation

Structure: needleleaf or dwarf tree scrub woodland/low scrub/graminoids/moss; () = stratum may be absent, / = "over"
Major species: *Picea mariana, Ledum palustre, Vaccinium uliginosum, Eriophorum vaginatum, Sphagnum spp.*
Vegetation site type: Tussock wetland (Chapter 7)

Major Landscape-Forming Processes

Biochemical reduction
Cryoturbation and ice-segregation
Flooding and alluviation (past) - produced the plain on which the map unit occurs; surface is now too high to be flooded by major rivers; some local flooding by small streams still occurs, with minor alluvial deposition

Herbivory - willows browsed by moose; microtine sign common
Icing (potential) - likely to occur if drainage is obstructed
Soil organic-matter accumulation
Succession (Chapter 7)
Thermokarst - produces thermokarst pits (component 2)
Throughflow - through permeable surface organic horizons
Wildfire - spreads readily in graminoids

Component 2: Thermokarst pits and ribbed fens

Setting

Area covered by component: 0 to 60% of map unit
Position on the landscape: depressions on stream terraces
Geologic material: organic matter over alluvium
Slope steepness: 0 to 2%
Slope shape: plane to concave

Soil

Soil name: Histosols, ponded (Chapter 6)
Soil profile:

Organic matter

Silt loam, loam,
sandy loam

Thickness of the organic mat: median more than 100 cm (range 50 to more than 100 cm)
Water table (Jul-Aug): median depth to water table 5 cm (range 0 to 12 cm)
Redoximorphic features: mineral soil (where observed) has low chroma matrix

Vegetation

Structure: (open low scrub)/graminoids/moss; () = stratum may be absent, / = "over"
Major species: *Chamaedaphne calyculata, Carex spp., Sphagnum spp.*
Vegetation site type: Thermokarst depressions; Ribbed fens (Chapter 7)

Major Landscape-Forming Processes

Biochemical reduction
Flooding and alluviation (past) - produced the plain on which the wetlands now occur; surface is now too high to be flooded by major rivers
Groundwater discharge - leads to wetness, higher pH than in surrounding areas; maintains taliks (permafrost-free areas) due to heat introduced with the water.
Icing (potential) - could occur if drainage is obstructed
Soil organic-matter accumulation
Thermokarst - produces the thermokarst pits from components 1 and 4; subsidence of 0.5 to 3 m relative to components 1 and 4
Throughflow - through permeable surface organic horizons on string fens and in thermokarst pits that are connected with the surface drainage network; occurs whenever the soil is unfrozen

Component 3: Frozen terraces, minerotrophic

Setting

Area covered by component: 0 to 50% of map unit
Position on the landscape: stream terraces near mountain footslopes
Geologic material: organic matter over alluvium
Slope steepness: 0 to 3%
Slope shape: plane

Soil

Soil name: Cryaquepts, gravelly substratum (Chapter 6)
Soil profile:

Organic matter

Silt loam or gravelly
silt loam

Permanently frozen:
silt loam or
gravelly silt loam

Thickness of the organic mat: median 10 cm (range 5 to 75 cm)
Depth to frozen soil (Jul-Aug): median 75 cm (range 60 to 80 cm)
Water table (Jul-Aug): usually present within 10 cm of the surface
Redoximorphic features: low-chroma matrix throughout the mineral soil

Vegetation

Structure: low scrub/graminoids/moss; () = stratum may be absent, / = "over"
Major species: *Betula glandulosa, Salix spp., Vaccinium uliginosum, Calamagrostis canadensis, Sphagnum spp.*
Vegetation site type: Frozen terraces, minerotrophic (Chapter 7)

Major Landscape-Forming Processes

Biochemical reduction
Flooding and alluviation (past) - produced the plain on which the wetlands now occur; surface is now too high to be flooded by major rivers; some local flooding by small streams still occurs, with minor alluvial deposition
Groundwater discharge - occurs mainly in unfrozen, sedge-rich areas; leads to wetness, higher pH than in surrounding areas; maintains taliks (permafrost-free areas) due to heat introduced with the water.
Icing (potential) - likely to occur if drainage is obstructed
Soil organic-matter accumulation
Throughflow - through permeable surface organic horizons

Component 4: Palsas and peat plateaus

Setting

Area covered by component: 0 to 20% of map unit
Position on the landscape: stream terraces
Geologic material: organic matter
Slope steepness: 0 to 5%; steeper escarpments
Slope shape: plane to convex

Soil

Soil name: Histosols (Chapter 6)
Soil profile:

Slightly decomposed
organic matter

Moderately to highly decomposed
organic matter

Permanently frozen: moderately
to highly decomposed organic
matter

Thickness of the organic mat: more than 0.5 m
Depth to moderately or highly decomposed organic matter: 7 to 23 cm
Depth to frozen soil (Jul-Aug): median 40 cm (range 32 to 45 cm)
Water table (Jul-Aug): occasionally present in the lower half of the thawed layer

Vegetation

Structure: needleleaf woodland/low scrub/lichens and moss; () = stratum may be absent, / = "over"
Major species: *Picea mariana, Betula glandulosa, Ledum palustre, Vaccinium uliginosum, Sphagnum spp., Cladina spp.*
Vegetation site type: Peat plateaus (Chapter 7)

Major Landscape-Forming Processes

Flooding and alluviation (past) - produced the plain on which the wetlands now occur; surface is now too high to be flooded by major rivers
Herbivory - microtine sign common
Ice-segregation - is responsible for uplifting of palsas and peat plateaus; vertical heave due to ice segregation ranges from 0.5 to 3 m
Soil organic-matter accumulation - most of component is currently rather dry, thus most of the organic-matter accumulation must have occurred in the past, before uplift by ice-segregation
Succession (Chapter 7)
Thermokarst - produces wet hollows; subsidence of 0.5 to 3 m
Throughflow - through permeable surface organic horizons
Wildfire - spreads readily in black spruce, lichens, and moss; deep peat fires are possible.

Minor Components

*drier soils on high spots
*pingos
*flood plains of small streams
*wet spots without permafrost in components 1 and 3 where groundwater discharges

Chapter 4: Soil Properties Summary Tables

Engineering index properties (Table 9)

Table 9 gives estimates of the engineering classification and the range of index properties for the major layers of soils in the study area. The approximate depth to the upper and lower boundaries of each layer is indicated. The range in thickness of the layers and more information on their properties are given in the Chapters 3 and 6.

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 mm in diameter. If the content of particles coarser than sand is more than 15%, an appropriate modifier is added, for example, "gravelly." Textural terms are defined in the Glossary.

Classification of the soils is given according to the Unified soil classification system (American Society of Testing and Materials, 1974) and the system of the American Association of State Highway and Transportation Officials (1970).

The percentage of soil particles passing a USA Standard Series No. 10 sieve (2 mm openings) is based on visual field estimates.

Liquid limit and *plasticity index* (Atterberg limits) estimates were made from field textures using Soil Conservation Service guidelines (Soil Conservation Service, 1984).

Physical and chemical properties (Table 10)

Table 10 gives estimates of physical and chemical properties for the major layers of soils in the study area. The approximate depth to the upper and lower boundaries of each layer is indicated.

Permeability estimates indicate the rate of downward movement of water when the soil is saturated. These estimates were made using SCS guidelines (Soil Conservation Service, 1984) and are based on soil characteristics observed in the field (primarily texture).

Available water capacity refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage is given in centimeters of water per centimeter of soil for each major soil layer. Estimates were made from soil texture using SCS guidelines (Soil Conservation Service, 1984). Available water capacities for most organic soil materials is currently unknown.

The *pH* range for each major layer is based on field tests using indicator solutions.

Shrink-swell potential is the potential for volume change in a soil with a loss or gain in moisture. Estimates were made from field textures using SCS guidelines (Soil Conservation Service, 1984). Shrink-swell potential is low in most of the study soils because the clay content is low.

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) to predict the average annual rate of soil loss by sheet and rill erosion in English tons per acre per year. The estimates are based primarily on percent of silt, sand, and organic matter, and on soil structure and permeability. The higher the value, the more susceptible the soil is to sheet and rill erosion by water.

Erosion factor T is an estimate of the maximum average annual rate of soil erosion by wind or water that can occur without affecting plant productivity over a sustained period. The rate is in English tons per acre per year (multiply by 2.24 to find metric tons per hectare

per year).

Wind erodibility groups are made up of soils that have similar properties affecting their resistance to wind erosion in unvegetated areas. The groups indicate the susceptibility of soil to wind erosion and the amount of soil lost. Wind erodibility group 1 is most susceptible to wind erosion, while group 8 is not susceptible.

Water features (Table 11)

Flooding, the temporary inundation of an area, is caused by overflowing streams. Water standing for short periods after rainfall or snowmelt is not considered flooding, nor is water in wetlands. Frequency, duration, and probable dates of flooding are estimated from vegetation and evidence in the soil. Frequency is expressed as none, rare, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely (averaging less than once in 20 years) but possible under unusual conditions; *occasional* that it occurs, on the average, once in 2 to 20 years; and *frequent* that it occurs, on the average, more than once in 2 years. Duration is expressed as *brief* if 2 to 7 days and *long* if more than 7 days. Probable dates are expressed in months; Apr-Oct, for example, means that flooding can occur during the period April through October.

High water table (seasonal) is the highest level of a saturated zone in the soil in most years. The estimates are based on the evidence of a saturated zone, namely grayish colors or mottles in the soil, and measurements of depth to water or saturated soil in boreholes. Indicated in Table 11 are the depth to the seasonal high water table; the kind of water table (if perched near the surface on an impermeable layer); and the months of the year that the water table commonly is high. A water table that is seasonally high for less than 1 month is not indicated in Table 11. Only saturated zones within a depth of about 1.5 m are indicated.

Hydrologic soil groups are used to estimate runoff from precipitation. Soils not protected by vegetation are assigned to one of four groups. They are grouped according to the intake of water when the soils are thoroughly wet and receiving precipitation from a long-duration storm.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of soils that have a permanent high water table and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

Soil drainage is an indicator of the overall wetness of the soil and its ability to dry after rainfall. The classes are excessively (E), well (W), moderately well (MW), somewhat poorly (SP), poorly (P), and very poorly (VP) drained.

Icing hazard is the likelihood of ice buildup by repeated overflow of water. The hazard is considered high along small streams, on gravel bars of large rivers, and in areas of

groundwater discharge. The hazard is considered moderate on long slopes with permafrost, in thermokarsting areas that show evidence of lateral seepage of water in depressions, and in floodplain depressions or abandoned channels with herbaceous or scrub vegetation.

Soil features (Table 12)

Risk of thaw subsidence is the likelihood of surface subsidence due to thawing of ground ice after disturbance of the soil surface. Soils with *high* risk show thermokarst subsidence under natural conditions and massive ground ice is known to be present. Soils with a *moderate* risk rarely thermokarst under natural conditions but have permafrost and at least 2 m of loamy, frost-susceptible material that is probably ice-rich. These areas could subside if the surface is disturbed and should be investigated thoroughly before construction. Soils with *low* risk lack permafrost or have permafrost with low ice content.

Potential frost action is the likelihood of upward or lateral expansion of the soil caused by the formation of segregated ice lenses (frost heave) and the subsequent collapse of the soil and loss of strength on thawing. Potentials were estimated from soil texture and wetness. Silty soils that have a high water table are the most susceptible to frost action. Well drained, very gravelly, or very sandy soils are the least susceptible. Frost heave and low soil strength during thawing cause damage to pavements and other rigid structures.

Depth to bedrock is given if bedrock is within a depth of 1.5 m. Depths are approximate due to the stony nature of soils over bedrock. In most soils rated "$>$1.5 m" the depth to bedrock is considerably greater than 1.5 m.

Risk of corrosion pertains to potential soil-induced electrochemical or chemical action that dissolves or weakens uncoated steel or concrete. The risk of corrosion for both uncoated steel and concrete, expressed as *low, moderate*, or *high*, is based on mainly on soil acidity (Soil Conservation Service, 1984).

TABLE 9.--ENGINEERING INDEX PROPERTIES

				CLASSIFICATION				
Map Unit	Component	Depth, cm	USDA Texture	Unified	AASHTO	% Passing Seive No 10	Liquid Limit	Plasticity Index
Ad	1	0-75	SIL, SL, GR-SL	ML, SM	A-4, A-5, A-2	60-100	0-50	NP-10
	1	75-150	GRV-SL, GRX-S	GM, GW	A-1	10-40	0	NP
	2	0-45	SIL, SL, GR-SL	ML, SM	A-4, A-5, A-2	90-100	0-50	NP-10
	2	45-100	GRV-LS, GRX-S	GW, GM	A-1	10-50	0	NP
	3	0-25	PEAT, MUCK	PT	A-8	100	-	-
	3	25-55	SIL, L, GR-L	ML	A-4, A-5	70-100	30-50	NP-10
	3	55-100	FRZN: SIL, L, GR-L	ML	A-4, A-5	70-100	30-50	NP-10
Ae	1	0-25	PEAT, MUCK	PT	A-8	100	-	-
	1	25-30	SIL, L	ML	A-4, A-5	100	30-50	NP-10
	1	30-100	FRZN: SIL, L, GR-L	ML	A-4, A-5	70-100	30-50	NP-10
	2	0-25	PEAT, MUCK	PT	A-8	100	-	-
	2	25-30	SIL, L, GR-L	ML	A-4, A-5	70-100	30-50	NP-10
	2	30-100	FRZN: SIL, L, GR-L	ML	A-4, A-5	70-100	30-50	NP-10
	3	0-10	SIL, SL, GR-SL	ML, SM	A-4, A-5, A-2	90-100	0-50	NP-10
	3	10-100	GRV-LS, GRX-S	GW, GM	A-1	10-50	0	NP
	4	-	-	-	-	-	-	-
	5	0-35	PEAT, MUCK	PT	A-8	100	-	-
	5	35-100	FRZN: MUCK, MUCKY PEAT; ICE	PT	A-8	100	-	-
Ah	1	0-20	PEAT, MUCK	PT	A-8	100	-	-
	1	20-45	SIL, L, GR-L	ML	A-4, A-5	70-100	30-50	NP-10
	1	45-100	FRZN: SIL, L, GR-L	ML	A-4, A-5	70-100	30-50	NP-10
	2	0-40	SIL, SL, GR-SL	ML, SM	A-4, A-5, A-2	90-100	0-50	NP-10
	2	40-100	GRV-LS, GRX-S	GW, GM	A-1	10-50	0	NP
	3	0-140	SIL, SL, GR-SL	ML, SM	A-4, A-5, A-2	60-100	0-50	NP-10
	3	140-150	GRV-SL, GRX-S	GM, GW	A-1	10-40	0	NP
	4	-	-	-	-	-	-	-

				CLASSIFICATION				
Map Unit	Component	Depth, cm	USDA Texture	Unified	AASHTO	% Passing Seive No 10	Liquid Limit	Plasticity Index
Aw	1	0-30	PEAT, MUCK	PT	A-8	100	-	-
	1	30-50	SIL, L	ML	A-4, A-5	100	30-50	NP-10
	1	50-100	FRZN: SIL, L, GR-L	ML	A-4, A-5	70-100	30-50	NP-10
	2	0-40	SIL, SL, GR-SL	ML, SM	A-4, A-5, A-2	90-100	0-50	NP-10
	2	40-100	GRV-LS, GRX-S	GW, GM	A-1	10-50	0	NP
	3	0-20	PEAT	PT	A-8	100	-	-
	3	20-30	MUCK, MUCKY PEAT	PT	A-8	100	-	-
	3	30-100	FRZN: MUCK, MUCKY PEAT; ICE	PT	A-8	100	-	-
	4	0-140	PEAT	PT	A-8	100	-	-
	4	140-150	MK-SIL, SL	ML, OL, SM	A-4, A-5	95-100	0-100	NP
	5		-	-	-	-	-	-
Ca	1	0-20	PEAT, MUCK	PT	A-8	100	-	-
	1	20-50	SIL, SL, GR-SL	ML, SM	A-4, A-5, A-2	60-100	0-50	NP-10
	1	50-100	FRZN: SIL, GR-L, GRV-SL	ML, SM, GM	A-4, A-5, A-2	30-100	0-50	NP-10
	2	0-40	SIL, SL, GR-SL	ML, SM	A-4, A-5, A-2	60-100	0-50	NP-10
	2	40-100	GRV-L, GRX-SL	GM	A-1, A-2	5-50	0	NP
	3	0-80	SIL, SL, GR-SL	ML, SM	A-4, A-5, A-2	60-100	0-50	NP-10
	3	80-150	GRV-SL, GRX-S	GM, GW	A-1	10-40	0	NP
	4	0-50	SIL, L, GRV-L	ML, SM	A-4, A-5, A-2	30-100	20-50	NP-10
	4	50-100	FRZN: SIL, GRV-L, GRX-SL	ML, SM, GM	A-4, A-5, A-2	10-100	20-50	NP-10
	5	-	-	-	-	-	-	-
Ck	1	0-25	PEAT, MUCK	PT	A-8	100	-	-
	1	25-50	SIL, SL, GR-SL	ML, SM	A-4, A-5, A-2	60-100	0-50	NP-10
	1	50-100	FRZN: SIL, GR-L, GRV-SL	ML, SM, GM	A-4, A-5, A-2	30-100	0-50	NP-10
	2	0-100	SIL, SL, GR-SL	ML, SM	A-4, A-5, A-2	60-100	0-50	NP-10
	2	100-150	GRV-SL, GRX-S	GM, GW	A-1	10-40	0	NP
	3	0-30	SIL, SL, GR-SL	ML, SM	A-4, A-5, A-2	60-100	0-50	NP-10
	3	30-150	GRV-L, GRX-SL	GM	A-1, A-2	5-50	0	NP
	4	-	-	-	-	-	-	-

				CLASSIFICATION				
Map Unit	Component	Depth, cm	USDA Texture	Unified	AASHTO	% Passing Seive No 10	Liquid Limit	Plasticity Index
Cs	1	0-20	PEAT, MUCK	PT	A-8	100	-	-
	1	20-45	SIL, SL, GR-SL	ML, SM	A-4, A-5, A-2	60-100	0-50	NP-10
	1	45-100	FRZN: SIL, GR-L, GRV-SL	ML, SM, GM	A-4, A-5, A-2	30-100	0-50	NP-10
	2	0-20	SIL, SL, GR-L	ML, SM	A-4, A-5, A-2	85-100	0-50	NP-10
	2	20-100	GRV-SIL, GRX-SL	GM	A-2	15-35	0-50	NP-10
	3	0-30	SIL, L, GR-SL	SM, ML	A-2, A-4	50-90	0-30	NP-10
	3	30-100	GRV-L, GRX-SL	GM	A-1, A-2	10-50	0	NP
	4	0-50	SIL, SL, GR-SL	ML, SM	A-4, A-5, A-2	90-100	0-50	NP-10
	4	50-100	GRV-LS, GRX-S	GW, GM	A-1	10-50	0	NP
Fc	1	0-10	PEAT, MUCKY PEAT	PT	A-8	100	-	-
	1	10-55	SR/SIL-FS	ML, SM	A-4	90-100	0-30	NP-10
	1	55-100	FRZN: SR/SIL-FS	ML, SM	A-4	90-100	0-30	NP-10
	2	0-10	PEAT, MUCK	PT	A-8	100	-	-
	2	10-65	SR/SI-FS	ML, SM	A-4, A-2	100	0-30	NP-10
	2	65-100	S, GRX-COS	GW, SW	A-1	10-80	0	NP
	3	0-70	SR/SI-FS	ML, SM	A-4, A-2	100	0-30	NP-10
	3	70-150	SR/S-GRX-S	GW, SW	A-1	10-50	0	NP
Fr	1	0-15	PEAT, MUCKY PEAT	PT	A-8	100	-	-
	1	15-50	SR/SIL-FS	ML, SM	A-4	90-100	0-30	NP-10
	1	50-125	FRZN: SR/SIL-FS	ML, SM	A-4	90-100	0-30	NP-10
	1	125-150	FRZN: SR/S-GRX-S	GW, SW	A-1	10-50	0	NP
	2	0-30	SR/SI-FS	ML, SM	A-4, A-2	100	0-30	NP-10
	2	30-150	SR/S-GRX-S	GW, SW	A-1	10-50	0	NP
	3	0-5	SR/FS-SI	ML, SM	A-4, A-2	100	0-30	NP-10
	3	5-150	GRX-S, GRX-COS	GW	A-1	5-30	0	NP
	4	0-50	SR/SI-FS	ML, SM	A-4	100	0-30	NP-10
	4	50-150	SR/S-GRX-S	GW, SW	A-1	10-50	0	NP
	5	0-5	PEAT, MUCK	PT	A-8	100	-	-
	5	5-55	SR/SI-FS	ML, SM	A-4, A-2	100	0-30	NP-10
	5	55-100	S, GRX-COS	GW, SW	A-1	10-80	0	NP

				CLASSIFICATION				
Map Unit	Component	Depth, cm	USDA Texture	Unified	AASHTO	% Passing Seive No 10	Liquid Limit	Plasticity Index
Ke	1	0-80	SIL, VFSL	ML	A-4, A-5	85-100	30-50	NP-10
	1	80-100	FRZN: SIL, VFSL	ML	A-4, A-5	85-100	30-50	NP-10
	2	0-130	SIL, GR-SIL	ML	A-4, A-5	70-100	30-50	NP-10
	2	130-150	GRV-SL, GRV-S	GM, GW	A-1	30-50	0	NP
	3	0-30	PEAT, MUCK	PT	A-8	100	-	-
	3	30-35	SIL	ML	A-4, A-5	100	30-50	NP-10
	3	35-100	FRZN: SIL, L, GR-L	ML	A-4, A-5	70-100	30-50	NP-10
	4	0-20	PEAT, MUCK	PT	A-8	100	-	-
	4	20-50	SIL	ML	A-4, A-5	100	30-50	NP-10
	4	50-100	FRZN: SIL, L, GR-L	ML	A-4, A-5	70-100	30-50	NP-10
	5	-	-	-	-	-	-	-
Ko	1	0-15	PEAT, MUCK	PT	A-8	100	-	-
	1	15-45	SIL	ML	A-4, A-5	100	30-50	NP-10
	1	45-100	FRZN: SIL, L, GR-L	ML	A-4, A-5	70-100	30-50	NP-10
	2	0-20	PEAT, MUCK	PT	A-8	100	-	-
	2	20-25	SIL, L, GR-L	ML	A-4, A-5	70-100	30-50	NP-10
	2	25-100	FRZN: SIL, L, GR-L	ML	A-4, A-5	70-100	30-50	NP-10
	3	0-130	SIL, VFSL	ML	A-4, A-5	90-100	30-50	NP-10
	3	130-150	GRV-SL, GRV-S	GM, GW	A-1	30-50	0	NP
	4	0-130	SIL, SL, GR-SL	ML, SM	A-4, A-5, A-2	60-100	0-50	NP-10
	4	130-150	GRV-SL, GRX-S	GM, GW	A-1	10-40	0	NP
	5	0-40	PEAT, MUCK	PT	A-8	100	-	-
	5	40-100	FRZN: SIL, L, GR-L	ML	A-4, A-5	70-100	30-50	NP-10
	6	-	-	-	-	-	-	-

				CLASSIFICATION				
Map Unit	Component	Depth, cm	USDA Texture	Unified	AASHTO	% Passing Seive No 10	Liquid Limit	Plasticity Index
Kw	1	0-30	PEAT, MUCK	PT	A-8	100	-	-
	1	30-45	SIL	ML	A-4, A-5	100	30-50	NP-10
	1	45-100	FRZN: SIL, L, GR-L	ML	A-4, A-5	70-100	30-50	NP-10
	2	0-35	PEAT, MUCK	PT	A-8	100	-	-
	2	35-40	SIL	ML	A-4, A-5	100	30-50	NP-10
	2	40-100	FRZN: SIL, L, GR-L	ML	A-4, A-5	70-100	30-50	NP-10
	3	0-35	SIL, SL, GR-SL	ML, SM	A-4, A-5, A-2	90-100	0-50	NP-10
	3	35-100	GRV-LS, GRX-S	GW, GM	A-1	10-50	0	NP
	4	0-100	PEAT	PT	A-8	100	-	-
	4	100-150	MK-SIL, SL	ML, OL, SM	A-4, A-5	95-100	0-100	NP
Mh	1	0-5	SIL, GRV-L	ML, GM	A-4, A-5, A-2	50-100	20-50	NP-10
	1	5-100	GRX-SL, CB	GW	A-1	0-30	0	NP
	2	0-150	BEDROCK	-	-	-	-	-
Ml	1	0-5	SIL, SL, GR-SL	ML, SM	A-4, A-5, A-2	60-100	0-50	NP-10
	1	5-100	GRV-L, GRX-SL	GM	A-1, A-2	5-50	0	NP
	2	0-5	SIL, L, GR-SL	SM, ML	A-2, A-4	50-90	0-30	NP-10
	2	5-100	GRV-L, GRX-SL	GM	A-1, A-2	10-50	0	NP
	3	0-100	GRV-L, GRX-SL	GM	A-1, A-2	5-50	0	NP
	4	0-20	PEAT, MUCK	PT	A-8	100	-	-
	4	20-55	SIL, GRV-L, CBX-L	ML, GM	A-4, A-5, A-2	10-100	20-50	NP-10
	4	55-100	FRZN: GRV-L, CBX-L	GM	A-2	10-30	0-30	NP-5
Nu	1	0-35	SL, GR-SL	ML, SM	A-4, A-2	50-80	0-50	NP-10
	1	35-100	GRV-LS, GRX-S	GW, GM	A-1	10-50	0	NP
Td	1	0-30	SR/SIL-S	ML, SM	A-4, A-2	90-100	0-30	NP-10
	1	30-100	GRX-S, S	GW, SW	A-1	10-50	0	NP
To	1	0-140	SIL, SR/SIL-FS	ML, SM	A-4, A-5	90-100	0-50	NP-10
	1	140-150	GRX-S, S	GW, SW	A-1	10-40	0	NP
	2	0-15	PEAT, MUCK	PT	A-8	100	-	-
	2	15-50	SIL, SR/SIL-FS	ML, SM	A-4, A-5	100	0-50	NP-10
	2	50-100	FRZN: SIL, FS	ML, SM	A-4, A-5	100	0-50	NP-10

				CLASSIFICATION				
Map Unit	Component	Depth, cm	USDA Texture	Unified	AASHTO	% Passing Seive No 10	Liquid Limit	Plasticity Index
Tw	1	0-30	PEAT, MUCK	PT	A-8	100	-	-
	1	30-50	SIL, SR/SIL-FS	ML, SM	A-4, A-5	100	0-50	NP-10
	1	50-100	FRZN: SIL, FS	ML, SM	A-4, A-5	100	0-50	NP-10
	2	0-100	PEAT	PT	A-8	100	-	-
	2	100-150	MK-SIL, SL	ML, OL, SM	A-4, A-5	95-100	0-100	NP
	3	0-10	PEAT, MUCK	PT	A-8	100	-	-
	3	10-75	SIL, FS, GR-SIL	ML, SM	A-4, A-5	70-100	0-50	NP-10
	3	75-100	FRZN: SIL, FS, GR-SIL	ML, SM	A-4, A-5	70-100	0-50	NP-10
	4	0-15	PEAT	PT	A-8	100	-	-
	4	15-40	MUCK, MUCKY PEAT	PT	A-8	100	-	-
	4	40-100	FRZN: MUCK, MUCKY PEAT; ICE	PT	A-8	100	-	-

TABLE 10: PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS

Map Unit	Component	Depth, cm	Permeability, μm/s	Available Water Capacity, cm/cm	pH	Shrink-Swell Potential	Erosion Factor K	Erosion Factor T	Wind Erodibility Group
Ad	1	0-75	1-100	0.15-0.3	4.4-6.2	LOW	0.37	2	1
	1	75-150	10-100+	0.03-0.1	5.4-6.2	LOW	0.10		
	2	0-45	1-100	0.1-0.3	4.0-6.2	LOW	0.37	1	1
	2	45-100	10-100+	0.03-0.1	5.6-7.2	LOW	0.05		
	3	0-25	-	-	3.8-5.2	LOW	-	5	1
	3	25-55	1-100	0.2-0.3	5.2-6.4	LOW	0.37		
	3	55-100	<0.01	-	5.2-6.4	LOW	-		
Ae	1	0-25	-	-	3.8-5.2	LOW	-	5	1
	1	25-30	1-100	0.2-0.3	5.2-6.4	LOW	0.37		
	1	30-100	<0.01	-	5.2-6.4	LOW	-		
	2	0-25	-	-	3.8-5.2	LOW	-	5	1
	2	25-30	1-100	0.2-0.3	5.2-6.4	LOW	0.37		
	2	30-100	<0.01	-	5.2-6.4	LOW	-		
	3	0-10	1-100	0.1-0.3	4.0-6.2	LOW	0.37	1	1
	3	10-100	10-100+	0.03-0.1	5.6-7.2	LOW	0.05		
	4	-	-	-	-	-	-	-	-
	5	0-35	-	-	3.8-4.2	LOW	-	-	7
	5	35-100	<0.01	-	3.8-5.2	LOW	-		
Ah	1	0-20	-	-	3.8-5.2	LOW	-	5	1
	1	20-45	1-100	0.2-0.3	5.2-6.4	LOW	0.37		
	1	45-100	<0.01	-	5.2-6.4	LOW	-		
	2	0-40	1-100	0.1-0.3	4.0-6.2	LOW	0.37	1	1
	2	40-100	10-100+	0.03-0.1	5.6-7.2	LOW	0.05		
	3	0-140	1-100	0.15-0.3	4.4-6.2	LOW	0.37	2	1
	3	140-150	10-100+	0.03-0.1	5.4-6.2	LOW	0.10		
	4	-	-	-	-	LOW	-	-	-
Aw	1	0-30	-	-	3.8-5.2	LOW	-	5	1
	1	30-50	1-100	0.2-0.3	5.2-6.4	LOW	0.37		
	1	50-100	<0.01	-	5.2-6.4	LOW	-		
	2	0-40	1-100	0.1-0.3	4.0-6.2	LOW	0.37	1	1
	2	40-100	10-100+	0.03-0.1	5.6-7.2	LOW	0.05		
	3	0-20	10-100+	0.05-0.2	3.8-4.2	LOW	-	-	7
	3	20-30	0.1-10	0.2-0.5	3.8-4.2	LOW	-		5
	3	30-100	<0.01	-	3.8-5.2	LOW	-		
	4	0-140	10-100+	0.05-0.2	4.2-5.2	LOW	-	-	8
	4	140-150	1-10	0.15-0.5	5.2-6.2	LOW	-		
	5	-	-	-	-	-	-	-	-
Ca	1	0-20	-	-	4.0-5.2	LOW	-	3	1
	1	20-50	1-100	0.15-0.3	5.2-6.0	LOW	0.37		
	1	50-100	<0.01	-	5.4-6.0	LOW	-		
	2	0-40	1-100	0.15-0.3	4.4-5.8	LOW	0.37	1	1
	2	40-100	10-100	0.04-0.14	5.4-6.0	LOW	0.10		
	3	0-80	1-100	0.15-0.3	4.4-6.2	LOW	0.37	2	1
	3	80-150	10-100+	0.03-0.1	5.4-6.2	LOW	0.10		
	4	0-50	1-100	0.2-0.3	5.2-6.0	LOW	0.37	2	1
	4	50-100	<0.01	-	5.4-6.0	LOW	-		
	5	-	-	-	-	-	-	-	-

Map Unit	Component	Depth, cm	Permeability, μm/s	Available Water Capacity, cm/cm	pH	Shrink-Swell Potential	Erosion Factor K	Erosion Factor T	Wind Erodibility Group
Ck	1	0-25	-	-	4.0-5.2	LOW	-	3	1
	1	25-50	1-100	0.15-0.3	5.2-6.0	LOW	0.37		
	1	50-100	<0.01	-	5.4-6.0	LOW	-		
	2	0-100	1-100	0.15-0.3	4.4-6.2	LOW	0.37	2	1
	2	100-150	10-100+	0.03-0.1	5.4-6.2	LOW	0.10		
	3	0-30	1-100	0.15-0.3	4.4-5.8	LOW	0.37	1	1
	3	30-150	10-100	0.04-0.14	5.4-6.0	LOW	0.10		
	4	-	-	-	-	-	-	-	-
Cs	1	0-20	-	-	4.0-5.2	LOW	-	3	1
	1	20-45	1-100	0.15-0.3	5.2-6.0	LOW	0.37		
	1	45-100	<0.01	-	5.4-6.0	LOW	-		
	2	0-20	1-100	0.1-0.3	5.6-6.4	LOW	0.37	1	3
	2	20-100	10-100	0.05-0.15	5.6-6.4	LOW	0.10		
	3	0-30	1-100	0.1-0.25	4.8-5.6	LOW	0.32	1	3
	3	30-100	10-100+	0.02-0.1	5.2-5.8	LOW	0.10		
	4	0-50	1-100	0.1-0.3	4.0-6.2	LOW	0.37	1	1
	4	50-100	10-100+	0.03-0.1	5.6-7.2	LOW	0.05		
Fc	1	0-10	-	-	4.0-6.0	LOW	-	2	2
	1	10-55	1-100	0.15-0.25	5.6-6.6	LOW	0.32		
	1	55-100	<0.01	-	5.6-7.2	LOW	-		
	2	0-10	-	-	4.8-6.0	LOW	-	2	2
	2	10-65	1-100	0.15-0.25	5.4-6.4	LOW	0.32		
	2	65-100	100+	0.02-0.05	5.6-7.0	LOW	0.05		
	3	0-70	1-100	0.15-0.25	5.8-7.2	LOW	0.32	1	2
	3	70-150	100+	0.02-0.05	6.4-7.2	LOW	0.05		
Fr	1	0-15	-	-	4.0-6.0	LOW	-	2	2
	1	15-50	1-100	0.15-0.25	5.6-6.6	LOW	0.32		
	1	50-125	<0.01	-	5.6-7.2	LOW	-		
	1	125-150	<0.01	-	-	LOW	-		
	2	0-30	1-100	0.15-0.25	5.8-7.2	LOW	0.32	1	2
	2	30-150	100+	0.02-0.05	6.4-7.2	LOW	0.05		
	3	0-5	1-100	0.15-0.25	6.2-7.2	LOW	0.32	1	2
	3	5-150	100+	0.02-0.04	6.2-7.2	LOW	0.05		
	4	0-50	1-100	0.15-0.25	5.8-7.2	LOW	0.32	1	2
	4	50-150	100+	0.02-0.05	6.4-7.2	LOW	0.05		
	5	0-5	-	-	4.8-6.0	LOW	-	2	2
	5	5-55	1-100	0.15-0.25	5.4-6.4	LOW	0.32		
	5	55-100	100+	0.02-0.05	5.6-7.0	LOW	0.05		
Ke	1	0-80	1-10	0.2-0.3	5.0-6.4	LOW	0.37	5	1
	1	80-100	<0.01	-	5.8-6.4	LOW	-		
	2	0-130	1-10	0.2-0.3	5.2-6.4	LOW	0.37	3	1
	2	130-150	10-100+	0.02-0.1	5.4-6.4	LOW	0.10		
	3	0-30	-	-	3.8-5.2	LOW	-	5	1
	3	30-35	1-100	0.2-0.3	5.2-6.4	LOW	0.37		
	3	35-100	<0.01	-	5.2-6.4	LOW	-		
	4	0-20	-	-	3.8-5.2	LOW	-	5	1
	4	20-50	1-100	0.2-0.3	5.2-6.4	LOW	0.37		
	4	50-100	<0.01	-	5.2-6.4	LOW	-		
	5	-	-	-	-	-	-	-	-

TABLE 10: PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS

Map Unit	Component	Depth, cm	Permeability, µm/s	Available Water Capacity, cm/cm	pH	Shrink-Swell Potential	Erosion Factor K	Erosion Factor T	Wind Erodibility Group
Ko	1	0-15	-	-	3.8-5.2	LOW	-	5	1
	1	15-45	1-100	0.2-0.3	5.2-6.4	LOW	0.37		
	1	45-100	<0.01	-	5.2-6.4	LOW	-		
	2	0-20	-	-	3.8-5.2	LOW	-	5	1
	2	20-25	1-100	0.2-0.3	5.2-6.4	LOW	0.37		
	2	25-100	<0.01	-	5.2-6.4	LOW	-		
	3	0-130	1-10	0.2-0.3	5.2-6.4	LOW	0.37	3	1
	3	130-150	10-100+	0.02-0.1	5.4-6.4	LOW	0.10		
	4	0-130	1-100	0.15-0.3	4.4-6.2	LOW	0.37	3	1
	4	130-150	10-100+	0.03-0.1	5.4-6.2	LOW	0.10		
	5	0-40	-	-	3.8-5.2	LOW	-	5	1
	5	40-100	<0.01	-	5.2-6.4	LOW	-		
	6	-	-	-	-	-	-	-	-
Kw	1	0-30	-	-	3.8-5.2	LOW	-	5	1
	1	30-45	1-100	0.2-0.3	5.2-6.4	LOW	0.37		
	1	45-100	<0.01	-	5.2-6.4	LOW	-		
	2	0-35	-	-	3.8-5.2	LOW	-	5	1
	2	35-40	1-100	0.2-0.3	5.2-6.4	LOW	0.37		
	2	40-100	<0.01	-	5.2-6.4	LOW	-		
	3	0-35	1-100	0.1-0.3	4.0-6.2	LOW	0.37	1	1
	3	35-100	10-100+	0.03-0.1	5.6-7.2	LOW	0.05		
	4	0-100	10-100+	0.05-0.2	4.2-5.2	LOW	-	-	8
	4	100-150	1-10	0.15-0.5	5.2-6.2	LOW	-		
Mh	1	0-5	1-100	0.15-0.3	4.4-6.0	LOW	0.37	1	8
	1	5-100	10-100+	0.02-0.06	5.2-6.0	LOW	0.02		
	2	0-150	-	-	-	-	-	-	-
Ml	1	0-5	1-100	0.15-0.3	4.4-5.8	LOW	0.37	1	1
	1	5-100	10-100	0.04-0.14	5.4-6.0	LOW	0.10		
	2	0-5	1-100	0.1-0.25	4.8-5.6	LOW	0.32	1	3
	2	5-100	10-100+	0.02-0.1	5.2-5.8	LOW	0.10		
	3	0-100	10-100	0.04-0.14	5.4-6.0	LOW	0.10	1	1
	4	0-20	-	-	4.0-6.0	LOW	-	1	1
	4	20-55	1-100	0.1-0.3	5.0-6.0	LOW	0.37		
	4	55-100	<0,01	-	5.0-6.0	LOW			
Nu	1	0-35	1-100	0.1-0.3	4.0-6.2	LOW	0.37	1	1
	1	35-100	10-100+	0.03-0.1	5.6-6.2	LOW	0.05		
Td	1	0-30	1-100	0.15-0.25	4.0-6.2	LOW	0.32	1	1
	1	30-100	10-100+	0.03-0.1	5.6-7.2	LOW	0.05		
To	1	0-140	1-100	0.15-0.3	4.4-6.2	LOW	0.37	2	1
	1	140-150	10-100+	0.03-0.1	5.4-6.2	LOW	0.10		
	2	0-15	-	-	3.8-5.2	LOW	-	3	1
	2	15-50	1-100	0.15-0.3	5.6-6.4	LOW	0.37		
	2	50-100	<0.01	-	5.6-7.2	LOW	-		

Map Unit	Component	Depth, cm	Permeability, μm/s	Available Water Capacity, cm/cm	pH	Shrink-Swell Potential	Erosion Factor K	Erosion Factor T	Wind Erodibility Group
Tw	1	0-30	-	-	3.8-5.2	LOW	-	3	1
	1	30-50	1-100	0.15-0.3	5.6-6.4	LOW	0.37		
	1	50-100	<0.01	-	5.6-7.2	LOW	-		
	2	0-100	10-100+	0.05-0.2	4.2-5.2	LOW	-	-	8
	2	100-150	1-10	0.15-0.5	5.2-6.2	LOW	-		
	3	0-10	-	-	5.2-6.4	LOW	-	3	1
	3	10-75	1-100	0.15-0.3	5.6-6.4	LOW	0.37		
	3	75-100	<0.01	-	5.6-7.2	LOW	-		
	4	0-15	10-100+	0.05-0.2	3.8-4.2	LOW	-	-	7
	4	15-40	0.1-10	0.2-0.5	3.8-4.2	LOW	-		5
	4	40-100	<0.01	-	3.8-5.2	LOW	-		

TABLE 11.--WATER FEATURES

		Flooding			Water Table					
Map Unit	Comp-onent	Frequency	Duration	Months	Depth, m	Kind	Months	Hydrologic Group	Drainage	Icing Hazard
Ad	1	none			>1.5			B	MW-W	low
	2	none			>1.5			B	W-E	low
	3	none			0.1-0.5	perched	May-Nov	D	P	moderate
Ae	1	none			0.1-0.3	perched	May-Nov	D	P	low
	2	none			0.1-0.5	perched	May-Nov	D	P	moderate
	3	none			>1.5			B	W-E	low
	4	frequent	brief	Apr-Oct	0.1-0.5		Apr-Nov	D	P	high
	5	none			0-0.4	perched	May-Nov	D	SP-P	moderate
Ah	1	none			0.1-0.5	perched	May-Nov	D	P	moderate
	2	none			>1.5			B	W-E	low
	3	none			>1.5			B	MW-W	low
	4	frequent	brief	Apr-Oct	0.1-0.5		Apr-Nov	D	P	high
Aw	1	none			0.1-0.5	perched	May-Nov	D	P	low
	2	none			>1.5			B	W-E	low
	3	none			0.2-0.4	perched	May-Nov	D	SP-P	moderate
	4	none			0-0.1		Jan-Dec	D	VP	moderate
	5	frequent	brief	Apr-Oct	0.1-0.5		Apr-Nov	D	P	high
Ca	1	none			0.1-0.4	perched	May-Nov	D	P	moderate
	2	none			>1.5			B	W	low
	3	none			>1.5			B	MW-W	low
	4	none			0.1-0.9	perched	May-Nov	D	P	low
	5	frequent	brief	Apr-Oct	0-0.2		Apr-Nov	D	P	high

		Flooding			Water Table					
Map Unit	Comp-onent	Frequency	Duration	Months	Depth, m	Kind	Months	Hydrologic Group	Drainage	Icing Hazard
Ck	1	none			0.1-0.4	perched	May-Nov	D	P	moderate
	2	none			>1.5			B	MW-W	low
	3	none			>1.5			B	W	low
	4	frequent	brief	Apr-Oct	0-0.2		Apr-Nov	D	P	high
Cs	1	none			0.1-0.3	perched	May-Nov	D	P	moderate
	2	frequent	brief	Apr-Oct	0-0.5		Apr-Nov	D	MW-P	high
	3	none			>1.5			B	W	low
	4	none			>1.5			B	W-E	low
Fc	1	occasional	brief	Apr-Oct	0.1-0.5	perched	May-Nov	D	P	high
	2	occasional	long	Apr-Oct	0.1-1.0		Apr-Nov	D	P	high
	3	occasional	brief	Apr-Oct	>1.5			B	W	high
Fr	1	rare	brief	Apr-Oct	0.1-0.8	perched	May-Nov	D	P	low
	2	occasional	brief	Apr-Oct	>1.5			B	W	moderate
	3	frequent	brief	Apr-Oct	>1.0		Jan-Dec	A	E	high
	4	occasional	brief	Apr-Oct	>1.5			B	W	low
	5	occasional	long	Apr-Oct	0-0.5		Apr-Nov	D	P	moderate
Ke	1	none			0-0.2	perched	May-Nov	D	P	low
	2	none			>1.5			B	MW-W	low
	3	none			0.2-0.3	perched	May-Nov	D	P	low
	4	none			0.1-0.3	perched	May-Nov	D	P	moderate
	5	frequent	brief	Apr-Oct	0.1-0.5		Apr-Nov	D	P	high
Ko	1	none			0.1-0.2	perched	May-Nov	D	P	low
	2	none			0.1-0.3	perched	May-Nov	D	P	moderate
	3	none			>1.5			B	MW-W	low
	4	none			>1.5			B	MW-W	low
	5	none			0.2-0.5	perched	May-Nov	D	P	moderate
	6	frequent	brief	Apr-Oct	0.1-0.5		Apr-Nov	D	P	high

		Flooding			Water Table					
Map Unit	Comp-onent	Frequency	Duration	Months	Depth, m	Kind	Months	Hydrologic Group	Drainage	Icing Hazard
Kw	1	none			0.1-0.5	perched	May-Nov	D	P	low
	2	none			0.1-0.5	perched	May-Nov	D	P	low
	3	none			>1.5			B	W-E	low
	4	none			0-0.1		Jan-Dec	D	VP	moderate
Mh	1	none			>1.5			A	E	low
	2	none			>1.5			D	E	low
Ml	1	none			>1.5			B	W	low
	2	none			>1.5			B	W	low
	3	none			>1.5			B	W	low
	4	none			0.3-0.5	perched	May-Nov	D	P	moderate
Nu	1	none			>1.5			B	W-E	low
Td	1	none			>1.5			B	W-E	low
To	1	none			>1.5			B	MW-W	low
	2	none			0.1-0.4	perched	May-Nov	D	P	low
Tw	1	none			0.1-0.4	perched	May-Nov	D	P	high
	2	none			0-0.1		Jan-Dec	D	VP	high
	3	none			0-0.1	perched	May-Nov	D	P	high
	4	none			0.2-0.5	perched	May-Nov	D	SP-P	moderate

					Risk of Corrosion	
Map Unit	Comp-onent	Risk of Thaw Subsidence	Potential Frost Action	Estimated Depth to Bedrock, m	Uncoated Steel	Concrete
Ad	1	low	high	>1.5	moderate	moderate
	2	low	low-moderate	>1.5	moderate	moderate
	3	moderate	high	>1.5	moderate	moderate
Ae	1	moderate	high	>1.5	moderate	moderate
	2	moderate	high	>1.5	moderate	moderate
	3	low	low-moderate	>1.5	moderate	moderate
	4	moderate	high	>1.5	moderate	moderate
	5	high	high	>1.5	high	high
Ah	1	moderate	high	>1.5	moderate	moderate
	2	low	low-moderate	>1.5	moderate	moderate
	3	low	high	>1.5	moderate	moderate
	4	moderate	high	>1.5	moderate	moderate
Aw	1	high	high	>1.5	moderate	moderate
	2	low	low-moderate	>1.5	moderate	moderate
	3	high	high	>1.5	high	high
	4	low	high	>1.5	high	high
	5	moderate	high	>1.5	moderate	moderate
Ca	1	moderate	high	>1.5	moderate	moderate
	2	low	moderate	0.5-1.5	moderate	moderate
	3	low	high	>1.5	moderate	moderate
	4	moderate	high	>1.5	moderate	moderate
	5	moderate	high	>1.5	moderate	moderate
Ck	1	moderate	high	>1.5	moderate	moderate
	2	low	high	>1.5	moderate	moderate
	3	low	moderate	1-2	moderate	moderate
	4	moderate	high	>1.5	moderate	moderate
Cs	1	moderate	high	>1.5	moderate	moderate
	2	moderate	high	>1.5	moderate	moderate
	3	low	moderate	>1.5	moderate	moderate
	4	low	low-moderate	>1.5	moderate	moderate
Fc	1	low	high	>1.5	moderate	moderate
	2	low	high	>1.5	moderate	moderate
	3	low	moderate	>1.5	moderate	low
Fr	1	low	high	>1.5	moderate	moderate
	2	low	moderate	>1.5	moderate	low
	3	low	low	>1.5	moderate	low
	4	low	moderate	>1.5	moderate	low
	5	low	high	>1.5	moderate	moderate

TABLE 12: SOIL FEATURES

					Risk of Corrosion	
Map Unit	Comp-onent	Risk of Thaw Subsidence	Potential Frost Action	Estimated Depth to Bedrock, m	Uncoated Steel	Concrete
Ke	1	moderate	high	>1.5	moderate	moderate
	2	low	moderate	>1.5	moderate	moderate
	3	moderate	high	>1.5	moderate	moderate
	4	high	high	>1.5	moderate	moderate
	5	moderate	high	>1.5	moderate	moderate
Ko	1	moderate	high	>1.5	moderate	moderate
	2	moderate	high	>1.5	moderate	moderate
	3	low	moderate	>1.5	moderate	moderate
	4	low	high	>1.5	moderate	moderate
	5	high	high	>1.5	moderate	moderate
	6	moderate	high	>1.5	moderate	moderate
Kw	1	high	high	>1.5	moderate	moderate
	2	high	high	>1.5	moderate	moderate
	3	low	low-moderate	>1.5	moderate	moderate
	4	low	high	>1.5	high	high
Mh	1	low	low	0.5->1.5	moderate	moderate
	2	low	low	0	-	-
Ml	1	low	moderate	0.5-1.5	moderate	moderate
	2	low	moderate	>1.5	moderate	moderate
	3	low	moderate	0.5-1	moderate	moderate
	4	moderate	high	0.5-1.5	moderate	moderate
Nu	1	low	low	>1.5	moderate	moderate
Td	1	low	low-moderate	>1.5	moderate	moderate
To	1	low	high	>1.5	moderate	moderate
	2	moderate	high	>1.5	moderate	moderate
Tw	1	moderate	high	>1.5	moderate	moderate
	2	low	high	>1.5	high	high
	3	moderate	high	>1.5	moderate	moderate
	4	high	high	>1.5	high	high

Chapter 5: Land Use and Management

See Appendix II for details about the criteria used to rate soils for engineering uses.

Building site development (Table 13)

Table 13 shows the degree and kind of soil limitations that affect shallow excavations, small buildings, local roads, and septic tank absorption fields. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required. Special feasibility studies may be required where the soil limitations are severe.

Shallow excavations are trenches or holes dug to a maximum depth of 2 m for basements, utility lines, open ditches, and other purposes. The ease of digging, filling, and compacting is affected by the depth to bedrock or permafrost; stone content; soil texture; and slope. The time of the year that excavations can be made is affected by the depth to a high water table and the susceptibility of the soil to flooding. The resistance of the excavation walls or banks to sloughing or caving is affected by soil texture and wetness.

Small buildings are structures built on shallow foundations on undisturbed soil. The load limit is the same as that for single-family dwellings no higher than three stories. Ratings are made for small buildings without basements. A high water table, thaw subsidence, and organic layers can cause the movement of footings. A high water table, depth to bedrock or permafrost, large stones, slope, and flooding affect the ease of excavation and construction. Flooding and icing may damage structures or make them inaccessible. Landscaping and grading that require cuts and fills of more than 2 m are not considered.

Local roads have an all-weather surface and carry automobile and light truck traffic all year. They have a subgrade of cut or fill soil material, a base of gravel, crushed rock, or stabilized soil material, and a flexible or rigid surface. Cuts and fills are generally limited to less than 2 m. Depth to bedrock or permafrost, a high water table, flooding, large stones, and slope affect the ease of excavating and grading. Soil strength (as inferred from the engineering classification of the soil), frost action potential, and depth to a high water table affect the traffic supporting capacity. Icing can make roads difficult to maintain or impassable in the winter. Thaw subsidence produces an irregular road surface that may require costly repairs.

Septic tank absorption fields are areas where effluent from a septic tank is distributed into the soil through subsurface tiles or perforated pipe. Only that part of the soil between depths of 1 and 1.5 m is evaluated. Permeability, a high water table, depth to bedrock or permafrost, and flooding affect absorption of the effluent. Large stones, bedrock, or permafrost interfere with installation. Unsatisfactory performance of septic tank absorption fields, including excessively slow absorption of effluent, surfacing of effluent, and hillside seepage, can affect public health. Ground water can be polluted if highly permeable sand and gravel or fractured bedrock is less than 1 m below the base of the absorption field, if slope is excessive, or if the water table is near the surface. There must be unsaturated soil material beneath the absorption field to filter the effluent effectively. Many local ordinances require that this material be of a certain thickness.

Construction materials (Table 14)

Table 14 gives information about the soils as a source of roadfill, sand, gravel, and topsoil. The soils are rated good, fair, or poor as a source of roadfill and topsoil. They are rated as a probable or improbable source of sand and gravel. The ratings are based on soil properties and site features that affect the removal of the soil and its use as construction material. Normal compaction, minor processing, and other standard construction practices are assumed. Each soil is evaluated to a depth of 1.5 m.

Roadfill is soil material that is excavated in one place and used in road embankments in another place. In this table, the soils are rated as a source of roadfill for low embankments, generally less than 2 m high and less exacting in design than higher embankments. Soils rated *good* for roadfill contain significant amounts of sand or gravel or both. They have at least 1.5 m of suitable material, low shrink-swell potential, few cobbles and stones, and slopes of 15% or less. Depth to the water table is more than 1 m. Soils with rated *fair* meet the above requirements but have more than 35% silt- and clay-sized particles. Soils with rated *poor* have permafrost near the surface; many stones; slopes of more than 25%; depth to the water table of less than 0.3 m; or layers of suitable material that are too thin.

Sand and gravel are natural aggregates suitable for use in many kinds of construction with a minimum of processing. A soil rated as a *probable* source lacks permafrost and has a layer of sand or gravel with less than 12% silty fines. This material must be at least 1 m thick and less than 50%, by weight, large stones. All other soils are rated as an *improbable* source. Coarse fragments of soft bedrock, such as shale and siltstone, are not considered to be sand and gravel.

Topsoil is used to cover an area so that vegetation can be established and maintained. The upper 1 m of a soil is evaluated for use as topsoil. Also evaluated is the reclamation potential of the borrow area. Soils rated *good* have friable loamy material to a depth of at least 1 m. They are free of stones and cobbles, have little or no gravel, and have slopes of less than 8%. They respond well to fertilizer, and are not so wet that excavation is difficult. Soils rated *fair* are sandy soils, soils that have only 0.5 to 1 m of suitable material, soils that have an appreciable amount of gravel or stones, or soils that have slopes of 8 to 15%. The soils are not so wet that excavation is difficult. Soils rated *poor* are very sandy, have less than 0.5 m of suitable material, have a large amount of gravel or stones, have slopes of more than 15%, have permafrost, or have a water table near the surface.

Recreational facilities (Table 15)

The soils of the study area are rated in Table 15 according to their suitability for recreational facilities. The ratings are based on restrictive soil features, such as wetness, slope, and properties of the surface layer. Susceptibility to flooding is considered. Not considered in the ratings, but important in evaluating a site, are the location and accessibility of the area, the size and shape of the area and its scenic quality, access to water, the capacity of the soil to absorb septic tank effluent, and the ability of the soil to support vegetation.

In Table 15, the degree of soil limitation is expressed as slight, moderate, or severe. *Slight* means that soil properties are generally favorable and that limitations are minor and easily overcome. *Moderate* means that limitations can be overcome or alleviated by planning, design, or special maintenance. *Severe* means that soil properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design, intensive maintenance, limited use, or by a combination of these measures. *Fragile* indicates vegetation highly

vunerable to degradation by traffic. The information in Table 15 can be supplemented by other information in this study, for example, on septic tank absorption fields, dwellings without basements, and local roads (Table 13).

The best for soils *camp* and *picnic areas* have mild slopes and are not wet or subject to flooding during the period of use. The surface is mineral rather than organic material that would disintegrate under heavy use. The surface has few boulders and absorbs rainfall readily but remains firm.

Paths and trails for hiking, horseback riding, and off-road vehicles are rated for summer use. They should require little or no cutting and filling. The best soils are not wet, are firm after rains, and are not subject to flooding more than once a year during the period of use. They have moderate slopes and few or no stones or boulders on the surface. The surface is mineral rather than organic material that would disintegrate under heavy use, and subsidence due to thaw of ground ice is unlikely.

Wildlife habitat value (Table 16)

Information useful for judging the wildlife habitat value of the vegetation site types is given in Table 16.

The potential to produce fruticose lichens suitable for winter caribou forage is rated *high* on vegetation site types where the average cover by fruticose lichens (mainly *Cladina*) is more than 50% for sample stops with more than 100 years since fire; *medium* where that cover is 10 to 50%; and *low* where that cover is less than 10%. (The 50% boundary may seem high to some users. Note that these percentages are canopy cover estimates made by a single observer who was quite consistent, but may have estimated higher than most observers.) More detailed information on lichen cover is given in Chapter 7.

The potential to produce deciduous browse for moose is rated *high* if the average cover by *Salix* plus *Populus* is more than 30% on the site type, and that cover is affected little by fire or post-fire succession; *medium* on other site types where the average cover by *Salix* plus *Populus* is more than 10% during some period (0-10, 10-50, 50-100, or 100+ years) since the last fire; and *low* on all other site types. More detailed information on browse plants is given in Chapter 7.

Use by caribou, moose, and microtines is rated "+" if there are numerous field notes from a vegetation site type that signs of use were observed. These signs include: pellets and damage to lichens by foraging and trampling (caribou); pellets and twig truncation or breakage (moose); and pellets, runways, burrows, and clipped graminoids (microtines). Use is rated as "?" where some notes were made about wildlife use, but the small sample size makes the frequency of use uncertain.

The median tree height is given to portray the availability of large trees for cavity nests or large stick nests on each vegetation site type. Typically, 1 to 3 large trees were measured in the vicinity of selected transect stops. Since these trees were selected primarily for coring to determine the time since the last fire (i.e., they were not chosen objectively), these medians give only a rough idea of the size of the largest trees on the vegetation site types. A dash indicates few and/or small trees (<1 m tall).

Use of this report in wildlife studies. Most of the landscape ecosystem map units consist of several components with contrasting habitat conditions; in addition, fire and post-fire succession can alter the vegetation on any component. Thus, for many wildlife habitat studies, investigators will need to identify the map unit component and time since fire in their study areas.

Map unit components can be identified by first determining the map unit from the

1:63,360 scale maps, and then comparing the study area to various components listed in the map unit description (Chapter 3). In many cases, components can be identified from the air or from aerial photographs; in some cases, an on-ground check may be needed.

Wildlife dates can be obtained from Plate 2. Because of the patchy nature of most fires, fire dates for study areas should be confirmed on the ground if possible. Also, Plate 2 will need to be updated to portray fires after 1994. If the time since fire is known, typical vegetation characteristics can be obtained from Chapter 7.

In some cases, investigators may want to associate wildlife habitat information with the *vegetation site types,* as was done in Table 16. (The vegetation site types were produced by joining all map unit components with similar plant growth conditions; see Chapter 2, Methods.) The main advantage in associating information with the vegetation site types rather than map unit components is that adequate data sets are more easily obtained for the former. For example, component Kw3 is distant from floatplane access points and all examples in the Kobuk Preserve Unit have burned since 1950. Thus, to obtain a large data set or one with various successional stages, the investigator may decide to sample some of the eleven other map unit components with the same vegetation site type as Kw3, "Dry Terraces and Uplands (lichen woodland)", and then extrapolate the results to Kw3.

Use of the vegetation site types as habitat units may make data collection easier, but some caution is advised. For example, components Kw3 and Td1 are both included in site type "Dry terraces and uplands (lichen woodland)". However, Kw3 is hilltop knobs of lichen woodland amongst expanses of tussock wetland, while component Td1 is the extensive flat lichen woodland that composes most of map unit Td. These two map unit components have similar environments for plant growth, but due to their different settings would have different habitat value to many animals.

TABLE 13.--BUILDING SITE DEVELOPMENT

		SHALLOW EXCAVATIONS		SMALL BUILDINGS		LOCAL ROADS		SEPTIC TANK ABSORPTION FIELDS	
Map Unit	Comp-onent	Limitation	Cause	Limitation	Cause	Limitation	Cause	Limitation	Cause
Ad	1	moderate	slope	moderate	slope	severe	frost action, slope	severe	poor filter, slope
	2	severe	slope, cutbanks cave	severe	slope	severe	slope	severe	poor filter, slope
	3	severe	permafrost, wetness	severe	subsides, wetness	severe	subsides, wetness, frost action	severe	permafrost, wetness, subsides
Ae	1	severe	permafrost, wetness	severe	subsides, wetness	severe	subsides, wetness, frost action	severe	permafrost, wetness, subsides
	2	severe	permafrost, wetness	severe	subsides, wetness	severe	subsides, wetness, frost action	severe	permafrost, wetness, subsides
	3	severe	slope, cutbanks cave	severe	slope	severe	slope	severe	poor filter, slope
	4	severe	flooding, wetness	severe	flooding, wetness, icing	severe	flooding, wetness, icing	severe	flooding, wetness
	5	severe	permafrost, wetness	severe	subsides, low strength, wetness	severe	subsides, low strength, wetness	severe	permafrost, wetness, subsides
Ah	1	severe	permafrost, wetness	severe	subsides, wetness	severe	subsides, wetness, frost action	severe	permafrost, wetness, subsides
	2	severe	slope, cutbanks cave	severe	slope	severe	slope	severe	poor filter, slope
	3	slight	-	slight	-	severe	frost action	severe	poor filter
	4	severe	flooding, wetness	severe	flooding, wetness, icing	severe	flooding, wetness, icing	severe	flooding, wetness
Aw	1	severe	permafrost, wetness	severe	subsides, wetness	severe	subsides, wetness, frost action	severe	permafrost, wetness, subsides
	2	severe	cutbanks cave	slight	-	moderate	frost action	severe	poor filter

		SHALLOW EXCAVATIONS		SMALL BUILDINGS		LOCAL ROADS		SEPTIC TANK ABSORPTION FIELDS	
Map Unit	Comp-onent	Limitation	Cause	Limitation	Cause	Limitation	Cause	Limitation	Cause
Aw	3	severe	permafrost, wetness	severe	subsides, low strength, wetness	severe	subsides, low strength, wetness	severe	permafrost, wetness, subsides
	4	severe	wetness	severe	wetness, low strength	severe	wetness, low strength	severe	wetness, subsides
	5	severe	flooding, wetness	severe	flooding, wetness, icing	severe	flooding, wetness, icing	severe	flooding, wetness
Ca	1	severe	permafrost, wetness	severe	subsides, wetness	severe	subsides, wetness, frost action	severe	permafrost, wetness, subsides
	2	severe	depth to rock, slope	severe	slope	severe	slope, frost action	severe	depth to rock, poor filter, slope
	3	severe	slope	severe	slope	severe	slope, frost action	severe	poor filter, slope
	4	severe	permafrost, wetness, slope	severe	wetness, slope	severe	wetness, frost action, slope	severe	permafrost, wetness, slope
	5	severe	flooding, wetness, slope	severe	flooding, wetness, slope, icing	severe	flooding, wetness, slope, icing	severe	flooding, wetness, slope
Ck	1	severe	permafrost, wetness	severe	subsides, wetness	severe	subsides, wetness, frost action	severe	permafrost, wetness, subsides
	2	slight	-	slight	-	severe	frost action	moderate	percs slowly
	3	moderate	depth to rock	slight	-	moderate	frost action, slope	severe	poor filter, depth to rock
	4	severe	wetness, flooding, slope	severe	wetness, flooding, slope, icing	severe	wetness, flooding, slope, icing	severe	wetness, flooding, slope
Cs	1	severe	permafrost, wetness	severe	subsides, wetness	severe	subsides, wetness, frost action	severe	permafrost, wetness, subsides
	2	severe	flooding, wetness, slope	severe	flooding, wetness, icing	severe	flooding, wetness, icing	severe	flooding, wetness, poor filter
	3	severe	slope	severe	slope	severe	slope	severe	slope, poor filter

		SHALLOW EXCAVATIONS		SMALL BUILDINGS		LOCAL ROADS		SEPTIC TANK ABSORPTION FIELDS	
Map Unit	Comp-onent	Limitation	Cause	Limitation	Cause	Limitation	Cause	Limitation	Cause
Cs	4	severe	cutbanks cave	slight	-	moderate	frost action	severe	poor filter
Fc	1	severe	permafrost, wetness	severe	wetness, flooding, icing	severe	wetness, frost action, icing	severe	permafrost, wetness, flooding
	2	severe	wetness, cutbanks cave	severe	flooding, wetness, icing	severe	flooding, wetness, icing	severe	flooding, wetness, poor filter
	3	severe	cutbanks cave	severe	flooding, icing	severe	flooding, icing	severe	flooding, poor filter
Fr	1	severe	permafrost, wetness	severe	wetness, flooding	severe	wetness, frost action	severe	permafrost, wetness
	2	severe	cutbanks cave	severe	flooding	severe	flooding	severe	flooding, poor filter
	3	severe	cutbanks cave, flooding	severe	flooding, icing	severe	flooding, icing	severe	flooding, poor filter
	4	severe	cutbanks cave	severe	flooding	severe	flooding	severe	flooding
	5	severe	wetness	severe	flooding, wetness	severe	flooding, wetness, frost action	severe	flooding, wetness, poor filter
Ke	1	severe	permafrost, wetness	severe	subsides, wetness	severe	subsides, wetness, frost action	severe	permafrost, wetness, subsides
	2	slight	-	slight	-	moderate	frost action	moderate	percs slowly
	3	severe	permafrost, wetness	severe	subsides, wetness	severe	subsides, wetness, frost action	severe	permafrost, wetness, subsides
	4	severe	permafrost, wetness	severe	subsides, wetness	severe	subsides, wetness, frost action	severe	permafrost, wetness, subsides
	5	severe	flooding, wetness	severe	flooding, wetness, icing	severe	flooding, wetness, icing	severe	flooding, wetness
Ko	1	severe	permafrost, wetness	severe	subsides, wetness	severe	subsides, wetness, frost action	severe	permafrost, wetness, subsides
	2	severe	permafrost, wetness	severe	subsides, wetness	severe	subsides, wetness, frost action	severe	permafrost, wetness, subsides

		SHALLOW EXCAVATIONS		SMALL BUILDINGS		LOCAL ROADS		SEPTIC TANK ABSORPTION FIELDS	
Map Unit	Comp-onent	Limitation	Cause	Limitation	Cause	Limitation	Cause	Limitation	Cause
Ko	3	slight	-	slight	-	moderate	frost action	moderate	percs slowly
	4	slight	-	slight	-	severe	frost action	moderate	percs slowly
	5	severe	permafrost, wetness	severe	subsides, wetness	severe	subsides, wetness, frost action	severe	permafrost, wetness, subsides
	6	severe	flooding, wetness	severe	flooding, wetness, icing	severe	flooding, wetness, icing	severe	flooding, wetness
Kw	1	severe	permafrost, wetness	severe	subsides, wetness	severe	subsides, wetness, frost action	severe	permafrost, wetness, subsides
	2	severe	permafrost, wetness	severe	subsides, wetness	severe	subsides, wetness, frost action	severe	permafrost, wetness, subsides
	3	severe	cutbanks cave	slight	-	moderate	frost action	severe	poor filter
	4	severe	wetness	severe	wetness, low strength	severe	wetness, low strength	severe	wetness, subsides
Mh	1	severe	slope, depth to rock	severe	slope, too cobbly	severe	slope	severe	slope, poor filter, depth to rock
	2	severe	depth to rock, slope	severe	depth to rock, slope	severe	depth to rock, slope	severe	depth to rock, slope
Ml	1	severe	depth to rock, slope	severe	slope	severe	slope, frost action	severe	depth to rock, poor filter, slope
	2	severe	slope	severe	slope	severe	slope	severe	slope, poor filter
	3	severe	depth to rock, slope	moderate	slope, too cobbly	moderate	slope, too cobbly, frost action	severe	depth to rock, poor filter
	4	severe	slope, permafrost	severe	slope, wetness	severe	slope, wetness, frost action	severe	permafrost, slope, wetness
Nu	1	severe	slope, cutbanks cave	severe	slope	severe	slope	severe	poor filter, slope
Td	1	severe	cutbanks cave	slight	-	moderate	frost action	severe	poor filter

		SHALLOW EXCAVATIONS		SMALL BUILDINGS		LOCAL ROADS		SEPTIC TANK ABSORPTION FIELDS	
Map Unit	Comp-onent	Limitation	Cause	Limitation	Cause	Limitation	Cause	Limitation	Cause
To	1	slight	-	slight	-	severe	frost action	moderate	poor filter
	2	severe	permafrost, wetness	severe	subsides, wetness	severe	subsides, wetness, frost action	severe	permafrost, wetness, subsides
Tw	1	severe	permafrost, wetness	severe	subsides, wetness	severe	subsides, wetness, frost action	severe	permafrost, wetness, subsides
	2	severe	wetness	severe	wetness, low strength	severe	wetness, low strength, frost action	severe	wetness, subsides
	3	severe	permafrost, wetness	severe	subsides, wetness	severe	subsides, wetness, frost action	severe	permafrost, wetness, subsides
	4	severe	permafrost, wetness	severe	subsides, low strength, wetness	severe	subsides, low strength, wetness	severe	permafrost, wetness, subsides

TABLE 14.--CONSTRUCTION MATERIALS

		ROADFILL		SAND		GRAVEL		TOPSOIL	
Map Unit	Comp-onent	Rating	Explanation	Rating	Explanation	Rating	Explanation	Rating	Explanation
Ad	1	fair	frost susceptible	probable	-	probable	-	fair	area reclaim, thin layer
	2	good	-	probable	-	probable	-	poor	area reclaim, thin layer
	3	poor	permafrost, wetness	improbable	permafrost, excess fines	improbable	permafrost, excess fines	poor	permafrost, wetness
Ae	1	poor	permafrost, wetness	improbable	permafrost, excess fines	improbable	permafrost, excess fines	poor	permafrost, wetness
	2	poor	permafrost, wetness	improbable	permafrost, excess fines	improbable	permafrost, excess fines	poor	permafrost, wetness
	3	good	-	probable	-	probable	-	poor	area reclaim, thin layer
	4	poor	wetness	improbable	excess fines	improbable	excess fines	poor	wetness
	5	poor	permafrost, low strength, wetness	improbable	permafrost, excess humus	improbable	permafrost, excess humus	poor	permafrost, excess humus, wetness
Ah	1	poor	permafrost, wetness	improbable	permafrost, excess fines	improbable	permafrost, excess fines	poor	permafrost, wetness
	2	good	-	probable	-	probable	-	poor	area reclaim, thin layer
	3	fair	frost susceptible	improbable	excess fines	improbable	excess fines	fair	area reclaim, thin layer
	4	poor	wetness	improbable	excess fines, small stones	improbable	excess fines	poor	wetness
Aw	1	poor	permafrost, wetness	improbable	permafrost, excess fines	improbable	permafrost, excess fines	poor	permafrost, wetness
	2	good	-	probable	-	probable	-	poor	area reclaim, thin layer

		ROADFILL		SAND		GRAVEL		TOPSOIL	
Map Unit	Comp-onent	Rating	Explanation	Rating	Explanation	Rating	Explanation	Rating	Explanation
Aw	3	poor	permafrost, low strength, wetness	improbable	permafrost, excess humus	improbable	permafrost, excess humus	poor	permafrost, excess humus, wetness
	4	poor	low strength, wetness	improbable	excess humus	improbable	excess humus	poor	excess humus, wetness
	5	poor	wetness	improbable	excess fines, small stones	improbable	excess fines	poor	wetness
Ca	1	poor	permafrost, wetness	improbable	permafrost, excess fines	improbable	permafrost, excess fines	poor	permafrost, wetness
	2	poor	area reclaim, thin layer	improbable	excess fines	improbable	excess fines	poor	too gravelly
	3	fair	frost susceptible	improbable	excess fines	improbable	excess fines	fair	area reclaim, thin layer
	4	poor	permafrost, wetness	improbable	permafrost, excess fines	improbable	permafrost, excess fines	poor	permafrost, wetness
	5	poor	wetness	improbable	excess fines, small stones	improbable	excess fines	poor	wetness
Ck	1	poor	permafrost, wetness	improbable	permafrost, excess fines	improbable	permafrost, excess fines	poor	permafrost, wetness
	2	fair	frost susceptible	improbable	excess fines	improbable	excess fines	good	-
	3	poor	area reclaim, thin layer	improbable	excess fines	improbable	excess fines	poor	too gravelly
	4	poor	wetness	improbable	excess fines, small stones	improbable	excess fines	poor	wetness
Cs	1	poor	permafrost, wetness	improbable	permafrost, excess fines	improbable	permafrost, excess fines	poor	permafrost, wetness
	2	poor	wetness	improbable	excess fines	improbable	excess fines	poor	too gravelly, wetness, slope
	3	fair	slope	improbable	excess fines	improbable	excess fines	poor	too gravelly, slope

		ROADFILL		SAND		GRAVEL		TOPSOIL	
Map Unit	Comp-onent	Rating	Explanation	Rating	Explanation	Rating	Explanation	Rating	Explanation
Cs	4	good	-	probable	-	probable	-	poor	area reclaim, thin layer
Fc	1	poor	permafrost, wetness	improbable	permafrost	improbable	permafrost	poor	permafrost, wetness
	2	fair	wetness	probable	-	probable	-	poor	area reclaim, thin layer
	3	good	-	probable	-	probable	-	fair	thin layer, area reclaim
Fr	1	poor	permafrost, wetness	improbable	permafrost	improbable	permafrost	poor	permafrost, wetness
	2	good	-	probable	-	probable	-	poor	thin layer, area reclaim
	3	good	-	improbable	small stones	probable	-	poor	too gravelly
	4	good	-	probable	-	probable	-	fair	thin layer, area reclaim
	5	poor	wetness	probable	-	probable	-	poor	wetness, too gravelly
Ke	1	poor	permafrost, wetness	improbable	permafrost, excess fines	improbable	permafrost, excess fines	poor	permafrost, wetness
	2	fair	frost susceptible	improbable	excess fines	improbable	excess fines	good	-
	3	poor	permafrost, wetness	improbable	permafrost, excess fines	improbable	permafrost, excess fines	poor	permafrost, wetness
	4	poor	permafrost, wetness	improbable	permafrost, excess fines	improbable	permafrost, excess fines	poor	permafrost, wetness
	5	poor	wetness	improbable	excess fines, small stones	improbable	excess fines	poor	wetness
Ko	1	poor	permafrost, wetness	improbable	permafrost, excess fines	improbable	permafrost, excess fines	poor	permafrost, wetness
	2	poor	permafrost, wetness	improbable	permafrost, excess fines	improbable	permafrost, excess fines	poor	permafrost, wetness

		ROADFILL		SAND		GRAVEL		TOPSOIL	
Map Unit	Comp-onent	Rating	Explanation	Rating	Explanation	Rating	Explanation	Rating	Explanation
Ko	3	fair	frost susceptible	improbable	excess fines	improbable	excess fines	good	-
	4	fair	frost susceptible	improbable	excess fines	improbable	excess fines	good	-
	5	poor	permafrost, wetness	improbable	permafrost, excess fines	improbable	permafrost, excess fines	poor	permafrost, wetness
	6	poor	wetness	improbable	excess fines, small stones	improbable	excess fines	poor	wetness
Kw	1	poor	permafrost, wetness	improbable	permafrost, excess fines	improbable	permafrost, excess fines	poor	permafrost, wetness
	2	poor	permafrost, wetness	improbable	permafrost, excess fines	improbable	permafrost, excess fines	poor	permafrost, wetness
	3	good	-	probable	-	probable	-	poor	thin layer, area reclaim
	4	poor	low strength, wetness	improbable	excess humus	improbable	excess humus	poor	excess humus, wetness
Mh	1	poor	slope	improbable	too stoney	improbable	too stoney	poor	too stoney, slope
	2	poor	slope, too stoney	improbable	too stoney	improbable	too stoney	poor	too stoney, slope
Ml	1	poor	area reclaim, thin layer, slope	improbable	excess fines, too cobbly	improbable	excess fines	poor	thin layer, area reclaim
	2	poor	slope	improbable	excess fines	improbable	excess fines	poor	too gravelly, slope
	3	poor	area reclaim, thin layer	improbable	excess fines, too cobbly	improbable	excess fines	poor	thin layer, area reclaim
	4	poor	permafrost, wetness, slope	improbable	permafrost, too cobbly, excess fines	improbable	permafrost, excess fines	poor	permafrost, wetness, slope
Nu	1	good	-	probable	-	probable	-	poor	area reclaim, thin layer
Td	1	good	-	probable	-	probable	-	poor	area reclaim, thin layer

		ROADFILL		SAND		GRAVEL		TOPSOIL	
Map Unit	Comp-onent	Rating	Explanation	Rating	Explanation	Rating	Explanation	Rating	Explanation
To	1	fair	frost susceptible	improbable	excess fines	improbable	excess fines	fair	area reclaim
	2	poor	permafrost, wetness	improbable	permafrost, excess fines	improbable	permafrost, excess fines	poor	permafrost, wetness
Tw	1	poor	permafrost, wetness	improbable	permafrost, excess fines	improbable	permafrost, excess fines	poor	permafrost, wetness
	2	poor	low strength, wetness	improbable	excess humus	improbable	excess humus	poor	excess humus, wetness
	3	poor	permafrost, wetness	improbable	permafrost, excess fines	improbable	permafrost, excess fines	poor	permafrost, wetness
	4	poor	permafrost, low strength	improbable	permafrost, excess humus	improbable	permafrost, excess humus	poor	permafrost, excess humus

TABLE 15.--RECREATIONAL FACILITIES

		CAMP AREAS		PICNIC AREAS		PATHS AND TRAILS		OFF-ROAD VEHICLE TRAILS	
Map Unit	Comp-onent	Limitation	Cause	Limitation	Cause	Limitation	Cause	Limitation	Cause
Ad	1	moderate	slope	moderate	slope	severe	erodes	slight	-
	2	moderate	slope	moderate	slope	severe	erodes	moderate	slope
	3	severe	fragile, wetness	severe	fragile, wetness	severe	fragile, wetness	severe	fragile, wetness, subsides
Ae	1	severe	fragile, wetness	severe	fragile, wetness	severe	fragile, wetness	severe	fragile, wetness, subsides
	2	severe	fragile, wetness	severe	fragile, wetness	severe	fragile, wetness	severe	fragile, wetness, subsides
	3	moderate	slope	moderate	slope	severe	erodes	moderate	slope
	4	severe	flooding, wetness	severe	flooding, wetness	severe	wetness	severe	wetness, subsides
	5	severe	fragile, wetness	severe	fragile, wetness	severe	fragile, wetness	severe	fragile, wetness, subsides
Ah	1	severe	fragile, wetness	severe	fragile, wetness	severe	fragile, wetness, erodes	severe	fragile, wetness, subsides
	2	moderate	slope	moderate	slope	severe	erodes	slight	-
	3	slight	-	slight	-	slight	-	slight	-
	4	severe	flooding, wetness	severe	flooding, wetness	severe	wetness	severe	wetness, subsides
Aw	1	severe	fragile, wetness	severe	fragile, wetness	severe	fragile, wetness	severe	fragile, wetness, subsides
	2	slight	-	slight	-	slight	-	slight	-
	3	severe	fragile, wetness	severe	fragile, wetness	severe	fragile, wetness	severe	fragile, wetness, subsides
	4	severe	fragile, wetness	severe	fragile, wetness	severe	fragile, wetness	severe	fragile, wetness

		CAMP AREAS		PICNIC AREAS		PATHS AND TRAILS		OFF-ROAD VEHICLE TRAILS	
Map Unit	Comp-onent	Limitation	Cause	Limitation	Cause	Limitation	Cause	Limitation	Cause
Aw	5	severe	flooding, wetness	severe	flooding, wetness	severe	wetness	severe	wetness, subsides
Ca	1	severe	fragile, wetness	severe	fragile, wetness	severe	fragile, wetness	severe	fragile, wetness, subsides
	2	moderate	slope	moderate	slope	severe	erodes	slight	-
	3	moderate	slope	moderate	slope	severe	erodes	slight	-
	4	severe	fragile, wetness	severe	fragile, wetness	severe	fragile, wetness, erodes	severe	fragile, wetness, subsides
	5	severe	flooding, wetness	severe	flooding, wetness	severe	wetness, erodes	severe	wetness, subsides
Ck	1	severe	fragile, wetness	severe	fragile, wetness	severe	fragile, wetness	severe	fragile, wetness, subsides
	2	slight	-	slight	-	slight	-	slight	-
	3	slight	-	slight	-	slight	-	slight	-
	4	severe	flooding, wetness	severe	flooding, wetness	severe	wetness, erodes	severe	wetness, subsides
Cs	1	severe	fragile, wetness	severe	fragile, wetness	severe	fragile, wetness	severe	fragile, wetness, subsides
	2	severe	flooding, wetness, slope	severe	flooding, wetness, slope	severe	wetness	severe	wetness, subsides
	3	severe	slope	severe	slope	severe	slope, erodes	moderate	slope
	4	slight	-	slight	-	slight	-	slight	-
Fc	1	severe	fragile, wetness	severe	fragile, wetness	severe	fragile, wetness	severe	fragile, wetness
	2	severe	wetness, flooding	severe	wetness	severe	wetness	severe	wetness
	3	moderate	flooding	slight	-	slight	-	slight	-
Fr	1	severe	fragile, wetness	severe	fragile, wetness	severe	fragile, wetness	severe	fragile, wetness

		CAMP AREAS		PICNIC AREAS		PATHS AND TRAILS		OFF-ROAD VEHICLE TRAILS	
Map Unit	Comp-onent	Limitation	Cause	Limitation	Cause	Limitation	Cause	Limitation	Cause
Fr	2	severe	flooding	moderate	flooding	slight	-	slight	-
	3	severe	flooding	severe	flooding	moderate	flooding	moderate	flooding
	4	moderate	flooding	slight	-	slight	-	slight	-
	5	severe	wetness, flooding	severe	wetness	severe	wetness	severe	wetness
Ke	1	severe	fragile, wetness	severe	fragile, wetness	severe	fragile, wetness	severe	fragile, wetness, subsides
	2	slight	-	slight	-	slight	-	slight	-
	3	severe	fragile, wetness	severe	fragile, wetness	severe	fragile, wetness	severe	fragile, wetness, subsides
	4	severe	fragile, wetness	severe	fragile, wetness	severe	fragile, wetness	severe	fragile, wetness, subsides
	5	severe	flooding, wetness	severe	flooding, wetness	severe	wetness	severe	wetness, subsides
Ko	1	severe	fragile, wetness	severe	fragile, wetness	severe	fragile, wetness	severe	fragile, wetness, subsides
	2	severe	fragile, wetness	severe	fragile, wetness	severe	fragile, wetness, erodes	severe	fragile, wetness, subsides
	3	slight	-	slight	-	slight	-	slight	-
	4	moderate	slope	moderate	slope	slight	-	slight	-
	5	severe	fragile, wetness	severe	fragile, wetness	severe	fragile, wetness	severe	fragile, wetness, subsides
	6	severe	flooding, wetness	severe	flooding, wetness	severe	wetness	severe	wetness, subsides
Kw	1	severe	fragile, wetness	severe	fragile, wetness	severe	fragile, wetness	severe	fragile, wetness, subsides

		CAMP AREAS		PICNIC AREAS		PATHS AND TRAILS		OFF-ROAD VEHICLE TRAILS	
Map Unit	Comp-onent	Limitation	Cause	Limitation	Cause	Limitation	Cause	Limitation	Cause
Kw	2	severe	fragile, wetness	severe	fragile, wetness	severe	fragile, wetness	severe	fragile, wetness, subsides
	3	slight	-	slight	-	slight	-	slight	-
	4	severe	fragile, wetness	severe	fragile, wetness	severe	fragile, wetness	severe	fragile, wetness
Mh	1	severe	slope, too cobbly	severe	slope, too cobbly	severe	slope, too cobbly	severe	slope, too cobbly
	2	severe	slope, too cobbly	severe	slope, too cobbly	severe	slope, too cobbly	severe	slope, too cobbly
Ml	1	severe	slope	severe	slope	severe	slope, erodes	severe	slope
	2	severe	slope	severe	slope	severe	slope, erodes	severe	slope
	3	moderate	slope	moderate	slope	slight	-	severe	slope
	4	severe	fragile, wetness, slope	severe	fragile, wetness, slope	severe	fragile, wetness, slope	severe	fragile, wetness, slope
Nu	1	moderate	slope	moderate	slope	severe	erodes	moderate	slope
Td	1	slight	-	slight	-	slight	-	slight	-
To	1	slight	-	slight	-	slight	-	slight	-
	2	severe	fragile, wetness	severe	fragile, wetness	severe	fragile, wetness	severe	fragile, wetness, subsides
Tw	1	severe	fragile, wetness	severe	fragile, wetness	severe	fragile, wetness	severe	fragile, wetness, subsides
	2	severe	fragile, wetness	severe	fragile, wetness	severe	fragile, wetness	severe	fragile, wetness
	3	severe	fragile, wetness	severe	fragile, wetness	severe	fragile, wetness	severe	fragile, wetness, subsides
	4	severe	fragile, wetness	severe	fragile, wetness	severe	fragile, wetness	severe	fragile, wetness, subsides

TABLE 16. WILDLIFE HABITAT VALUE AND USE*

Lichen production potential	Caribou use	Browse production potential	Moose use	Microtine use	Median tree Height, m	Vegetation site type
low		high			-	Alpine small stream floodplains
medium		low			-	Alpine tundra
low		low			-	Avalanche tracks
medium		medium	?	?	7	Burn thaw-susceptible terraces and uplands
high	+	medium			7	Dry crests and upper slopes of low mountains (forest and scrub)
low		medium			22	Dry floodplain, small streams
low		high	+		11	Dry, occasionally flooded river floodplain (tall scrub and poplar forest)
low		medium	?		21	Dry, occasionally flooded river floodplain (white spruce/alder forest)
high	+	medium	?		5	Dry terraces and uplands (lichen woodland)
low		medium	+		16	Frozen floodplain of creeks
medium		low		+	6	Frozen moraines and terraces, forested
low		high			-	Frozen terraces, minerotrophic
low		medium	?		-	Gravel bars, frequently flooded
medium		low		+	12	Gravelly colluvium
low		medium			19	Low mountain midslopes, unfrozen (forest)
high	+	low		+	3	Mudboil tundra
high	+	low			6	Peat plateaus

Lichen production potential	Caribou use	Browse production potential	Moose use	Microtine use	Median tree Height, m	Vegetation site type
medium	+	low		?	-	Pit and mound depressions, tundra
medium		medium	+	+	9	Rarely flooded river floodplain with permafrost
low		low			-	Ribbed fens
low		high	+		12	Small stream floodplains in bedrock uplands
low		high	+		-	Small stream floodplains on moraines
medium		low			17	Steep forested high mountain slopes
medium		low			-	Steep north mountain slopes with permafrost
medium		medium		+	6	Striped colluvial slopes
low		low		?	-	Thermokarst depressions
medium		low		?	-	Tussock tundra
medium		low		?	5	Tussock wetland
low		high	+		-	Wet floodplain depressions
medium	?	low		?	5	Wet, nearly level areas with peat on moraines

*for definitions of low, medium, high, +, ?, and -, see text

Summary of Map Unit Suitabilities for a Transportation Corridor

Ad

Advantages:

- Part of this map unit lacks ice-rich permafrost.
- Coarse-grained materials are available near the surface over much of the unit.

Disadvantages:

- Dissected by small valleys and ravines that would require cut and fill.
- Lower slopes are underlain by ice-rich, silty deposits.

Ae

Advantages:

- Portions of this map unit lack ice-rich permafrost, have good drainage, and have coarse-grained material near the surface.

Disadvantages:

- Most of the map unit has a thermokarst hazard .
- Wet, silty surface materials are frost-susceptible.
- Crossings of component 5 are subject to icing.

Ah

Advantages:

- Areas with good drainage and coarse-grained material are present (component 2).

Disadvantages:

- Complex, with dry areas separated by slopes and depressional areas with probable ice-rich permafrost and thermokarst hazard.
- Dry areas are important caribou winter range; these areas compose a small proportion of the map unit and would be heavily impacted by the road itself and by gravel mining.
- Crossings of component 4 are subject to icing.

Aw

Advantages:

- Low grade

Disadvantages:

- Wetness
- Surface materials are weak organic matter and frost-susceptible silt.
- Thermokarst hazard on most of the map unit
- Crossings of component 5 are subject to icing.

Ca

Advantages:

- Contains some dry areas with shallow bedrock or coarse-grained materials (component 2).
- Part of this map unit lacks ice-rich permafrost (component 2 and probably component 3).

Disadvantages:

- Includes long slopes with thick accumulation of material with fine-grained matrix; this material is frost-susceptible and potentially subject to thermokarst and slope instability.
- Use of this map unit would require long slope traverses, with drainage and icing

problems.
- Crossings of component 5 are subject to icing.

Ck

Advantages:
- Contains some dry areas with shallow bedrock or coarse-grained materials (component 3).
- Part of this map unit lacks permafrost (component 3 and probably component 2).

Disadvantages:
- Contains long slopes with a thick accumulation of material with fine-grained matrix; this material is frost-susceptible and potentially subject to thermokarst and slope instability.
- Use of this map unit unit would require long slope traverses with drainage and icing problems.
- Crossings of component 4 are subject to icing.

Cs

Advantages:
- None

Disadvantages:
- Materials are frozen slope deposits with fine-grained matrix, frost-susceptible and potentially subject to thermokarst and slope instability.
- Use of this map unit would require long slope traverses with drainage and icing problems.

Fc

Advantages:
- Low grade
- Coarse-grained material is near the surface in most areas.
- Little ground ice is present.

Disadvantages:
- Cut by numerous channels and sloughs that must be bridged or filled
- Subject to bank erosion by creeks and thus would require rip-rap.
- Used by moose.
- Subject to flooding.
- Potential for icing if natural water flow is blocked

Fr

All components

Advantages:
- Low grade
- Little ground ice is present.
- Coarse-grained material is available near the surface.

Disadvantages:
- Cut by numerous sloughs that must be bridged or filled.
- Adjacent to the Kobuk River, and thus use of this map unit would harm the scenic value of the river.
- Subject to bank erosion by the river and thus would require riprapping in places.

Fr: Component 1

Advantages:

- Flooding is rare.

Disadvantages:

- Silty surface material is frost-susceptible.
- Granular material is located underneath saturated frozen silty material.

Fr: Components 2 and 4

Advantages:

- Good drainage

Disadvantages:

- Occur in discontinuous patches (and thus could only be utilized for part of the route).
- Support vegetation types that are rare in this region.
- Used heavily by moose (Component 2).
- Occasionally flooded
- Provide nesting sites for ospreys.

Fr: Component 3

Advantages:

- Good drainage

Disadvantages:

- Floods frequently and is subjected to scour by floating ice in the spring. This component would require extensive riprapping.
- Occurs in discontinuous patches (and thus could only be utilized for part of the route).

Fr: Component 5

Advantages:

- None

Disadvantages:

- Wetness, flooding
- Used heavily by moose.

Ke

Advantages:

- Portions of this map unit lack ice-rich permafrost and have good drainage (component 2).

Disadvantages:

- Most of the unit has a thermokarst hazard and is frost-susceptible and subject to cryoturbation.
- Caribou winter range
- Component 5 is subject to icing.

Ko

Advantages:

- Part of this map unit (component 3) is well drained and has granular materials near the surface.

Disadvantages:

- Slopes (component 1) are underlain by ice-rich, silty deposits.
- Crossings of component 6 are subject to icing.
- Most of this unit has silty, frost-susceptible surface material.

Kw

Advantages:

- Low grade

Disadvantages:

- Wetness
- Surface materials are weak organic matter and frost-susceptible silt.
- Thermokarst hazard

Mh

Advantages:

- Bedrock is near the surface and could be used for fill.

Disadvantages:

- Steep slopes, long climbs, and crossings of the undesirable map unit Cs are needed to utilize this unit.

Ml

Advantages:

- Bedrock is near the surface could be used for fill.

Disadvantages:

- Steep slopes, long climbs, and crossings of the undesirable unit Cs are needed to utilize this unit.

Nu

Advantages:

- Good drainage
- Coarse-grained material

Disadvantages:

- Steep, complex slopes would require cut and fill.
- Not extensive, and thus could only form a small part of any route.
- Important groundwater recharge area
- Caribou winter range (where map unit is not burned)

Td

Advantages:

- Coarse-grained material
- Good drainage

Disadvantages:

- Occurs in a few, small, disconnected areas.
- Caribou winter range

To

Advantages:

- Low grade
- Granular material at depth

- Thermokarst unlikely

Disadvantages:

- Surface materials are silty and frost-susceptible.
- Not extensive, and thus could only form a small part of any route.
- Part of this map unit has permafrost and is wet.

Tw

Advantages:

- Low grade
- Coarse-grained material is locally present at depth.

Disadvantages:

- High water table
- Surface materials are weak organic matter or frost-susceptible silt.
- Thermokarst hazard
- Icing hazard

Discussion of Proposed Transportation Corridor Routes

NOTE: This discussion is based primarily on information on the upper 1.5 m of material. Deeper materials should be investigated before construction of a road or railroad.

This section discusses the routes across the Kobuk Preserve Unit proposed in the "Alaska Transportation Corridor Study" (Alaska Transportation Corridor Consultants, 1972; Plates 3 and 4). In general, the Kobuk Preserve Unit presents problems to construction that are typical of Interior Alaska: poor drainage, permafrost, thermokarsting, frost-heave, intercepted drainage, and icing. Permafrost is particularly difficult to deal with in Interior Alaska because permafrost temperatures are not far below 0 C; thus some thawing of ground ice and consequent subsidence due to construction is unavoidable. Good foundation and fill materials are present in the Kobuk Preserve Unit, but they do not predominate.

Kobuk Corridor

The consultants assertion that "Except for short reaches of swampy ground near Norutak Lake, this alignment follows good foundation materials almost entirely" (p. 15) is probably overly optimistic. The route has a complex of conditions and would repeatedly cross sections with poor drainage and ice-rich materials.

The section from the east boundary of the Preserve near Norutak Lake westward for approximately 6 km presents some of the most difficult engineering problems in the Preserve. Routes must cross either map unit Aw, which here consists largely of component 3, Peat Plateaus (mainly ice-rich organic matter, probably the most unstable of all possible materials) or a long footslope of map unit Ca, (with hazards of thermokarst and intercepted drainage). The proposed railroad route crosses the Aw, apparently to avoid a hill climb, while the automobile route climbs onto the more suitable unit Ca. From about 6 km east of Lower Kobuk Canyon to the Kobuk River, both routes move onto map unit Ad, which is among the most suitable map units in the Preserve (though still containing a significant proportion of ice-rich silty slope deposits).

From the Kobuk River near the Lower Canyon to the western boundary of the Preserve, the need for low grades would force the railroad onto map unit Fr, with short sections of units Td and Tw. This route would require numerous bridges over the Kobuk River and its sloughs,

and filling of some sloughs. Extensive riprapping would be needed to prevent washout of railroad embankments. The railroad itself and borrow pits would heavily impact the relatively rare (in this region) floodplain willow scrub, poplar forest, and old-growth white spruce (map unit Fr, components 2, 3, and 4). Much fill would need to be mined to raise the bed above floods and to cross the difficult unit Tw.

Because roads are less constrained by grade than railroads, the road could be routed further from the river. From the Lower Canyon region to the Preserve's western boundary, the proposed road route runs along the south side of the River across units Ah and Ko. These units are among the most suitable of the extensive units in this region, although they still have ice-rich slope deposits as major components. The road itself and borrow pits would heavily impact the dry gravelly hilltops, which are the sites used by caribou for winter range. The detailed route map (Plate 4) shows the road drifting onto units and Fr, Aw, and Tw; the latter two units should be avoided if possible.

An alternative Kobuk corridor crosses the river west of Beaver Creek and runs north by Lake Selby to the western boundary of the Preserve (Plate 3). This option would require a bridge over the Kobuk River and then would be located mainly on units Ko and Ke, with some unit Ae near Lake Selby. Unit Ko is relatively suitable as discussed above, while unit Ke dominantly wet and subject to thermokarst and frost heave. Though unit Ae is dominantly wet and ice-rich, in the area of Ae south of Lake Selby the road could follow a major gravelly moraine ridge; portions of this ridge would be heavily impacted by the road itself and by mining of gravel fill for nearby wet, ice-rich areas.

Rift Valley Corridor

As the consultants state, this route (Plate 3) present more difficulties than the Kobuk Valley route due to wetness, ice-rich materials, and intercepted drainage, though problems are similar on both routes. From the eastern boundary of the Preserve to Walker Lake, the route crosses map units Ah and Aw. Most of map unit Aw and parts of map unit Ah are wet and subject to thermokarsting. Thus much gravel fill would be needed for road construction and repairs. The dry hilltops in map units Ah and Aw (used by caribou for winter range) would be impacted heavily, because the road would traverse them where possible and gravel would be mined from them.

In the area south of Walker Lake the proposed route passes out of the Preserve (and hence out of the study area) into the Park/Wilderness. There the proposed route apparently follow units Nu and Td, both of which are dry and well suited to construction. If the route were to stay in the Preserve while passing south of Walker Lake, it would instead cross units Cs, Tw, and Ca (which present the usual problems of wetness, ice-rich sediments, and intercepted drainage, although Ca has some dry portions).

Between Walker Lake and Nutuvukti Lake the route is primarily on unit Ca, which contains favorable dry ridgetops and unfavorable long sidehills with potentially ice-rich sediments. Note that a railroad would be less able to make the grades leading onto the ridgetops and would thus be forced onto lower slopes with poor foundation materials and intercepted drainage. Crossings of small streams (unit Fc) here may have icing problems. Northeast of Nutuvukti Lake the route is forced to cross some combination of units Tw, Aw, and Cs, all of which are difficult road substrates (due to wetness, permafrost, thermokarst hazard, and intercepted drainage) and would require much fill to construct and maintain. The route then continues westward north of Nutuvukti Lake to the Preserve boundary on unit Nu, which is dry and a good gravel source. Note that construction north of Nutuvukti Lake would impact the recharge zone of a unique wetland area, here referred to as the Nutuvukti fen (see "Hydrology" in Chapter 1).

Chapter 6: Detailed Soil Descriptions

Cryaquepts

Major taxonomic classes: Histic Pergelic Cryaquepts, Pergelic Cryaquepts, Ruptic-Histic Pergelic Cryaquepts
Depth class: very shallow to moderately deep (25 to 66 cm) over permafrost
Drainage class: poorly drained
Permeability: high in the slightly decomposed organic matter; moderate in the moderately decomposed organic matter and silt loam; impermeable in the frozen soil.
Position on landscape: glacial moraines
Map unit components: Ad3, Ae1, Ae2, Ah1, Aw1, Ke3, Ke4, Ko1, Ko2, Ko5, Kw1, Kw2
Parent material: loess or colluviated loess over glacial till or outwash
Slope range: 0 to 18%
Elevation: 91 to 457 m (300 to 1500 feet)

Typical Pedon

Cryaquept = on a 10% slope under open black spruce forest with low shrubs and moss at 152 m (500 feet) elevation

Oi 0 to 22 cm; dark brown (7.5YR 3/2) slightly decomposed organic matter; many very fine to coarse roots; extremely acid (pH 3.8); clear wavy boundary.

A 22 to 28 cm; black (10YR 2/1) mucky silt loam; weak medium subangular blocky structure; friable; slightly sticky and slightly plastic; few very fine roots; strongly acid (pH 5.4); clear broken boundary.

Bg 28 to 32 cm; dark grayish brown (2.5Y 4/2) silt loam; many medium prominent dark yellowish brown (10YR 4/6) mottles; massive; slightly sticky and slightly plastic; few very fine roots; moderately acid (pH 5.6); abrupt wavy boundary.

Bgf 32 to 37 cm; dark grayish brown (2.5Y 4/2) silt loam; many medium prominent dark yellowish brown (10YR 4/6) mottles; massive; slightly sticky and slightly plastic; moderately acid (pH 5.6).

Typical Pedon Location

Map unit in which located: Ko = Kobuk moraines
Location in survey area: 66 deg 44.8 min N, 155 deg 11.7 min W; transect 92DS019, stop 18; south of Kobuk River east of Bear Island.

Range in Characteristics

Thickness of the organic mat: median 24 cm (range 12 to 45 cm)
Water table (Jul-Aug): occasionally present near the mineral soil surface, and the thawed mineral soil is usually saturated
Depth to frozen soil (Jul-Aug): median 40 cm (range 25 to 66 cm)
Sample size: 159 summary descriptions, 29 full descriptions

Oi horizon:
Color = hue of 5YR or 7.5YR; value moist of 3 to 5; chroma moist of 2 to 8
Texture = peat
Rock fragments = 0%
Reaction = 3.8-4.8
Oa or Oe horizon:
Color = hue of 7.5YR of 10YR; value moist of 2 or 3; chroma moist of 1 or 2
Texture = mucky peat or muck
Rock fragments = 0%
Reaction = 4.2-5.2
A horizon:
Color = hue of 10YR; value moist of 2 or 3; chroma moist of 1 or 2
Texture = silt loam, mucky silt loam
Rock fragments = 0%
Reaction = 4.8-5.6
Bg horizon:
Color = hue of 2.5Y, 5Y, or N; value moist of 3 to 5; chroma moist of 1 or 2
Texture = silt loam, loam
Rock fragments = 0 to 5%
Reaction = 5.2-6.4
Bgf horizon:
Color = hue of 2.5Y, 5Y, or N; value moist of 3 to 5; chroma moist of 1 or 2
Texture = silt loam, loam
Rock fragments = 0 to 10%
Reaction = 5.2-6.4

Cryaquepts, gravelly substratum

Major taxonomic classes: Histic Pergelic Cryaquepts, Pergelic Cryaquepts
Depth class: very shallow to moderately deep (40 to 75 cm) over permafrost
Drainage class: poorly drained
Permeability: moderate to high in the organic mat; moderate in the loamy mineral soil; impermeable in the frozen soil
Position on landscape: stream terraces
Map unit components: To2, Tw1, Tw3
Parent material: alluvium
Slope range: 0 to 3%
Elevation: 91 to 244 m (300 to 800 feet)

Typical Pedon

Cryaquept = on a level slope under dwarf black spruce woodland with low shrubs, cottonsedge, and mosses at 213 m (700 feet) elevation

Oi 0 to 14 cm; strong brown (7.5YR 4/6) slightly decomposed organic matter; few fine to medium roots; extremely acid (pH 3.8); gradual smooth boundary.
Oe 14 to 32 cm; dark brown (7.5YR 3/2) moderately decomposed organic matter; few fine

to medium roots; extremely acid (pH 3.8); clear smooth boundary.

Bg 32 to 40 cm; gray (5Y 5/1) silt loam; moderate medium platy structure; slightly sticky and slightly plastic; moderately acid (pH 5.6); abrupt smooth boundary.

Bgf 40 to 47 cm; gray (5Y 5/1) frozen silt loam; massive; very hard; slightly sticky and slightly plastic; moderately acid (pH 5.6).

Typical Pedon Location

Map unit in which located: Tw = Wet river terraces

Location in survey area: 67deg 0.95 min N, 154 deg 20.4 min W; transect 92DS048, stop 02; near the Kobuk River below the Walker Lake outlet

Range in Characteristics

Thickness of the organic mat: median 26 cm (range 8 to 38 cm)

Water table (Jul-Aug): often present near the mineral soil surface, and the thawed mineral soil is usually saturated

Depth to frozen soil (Jul-Aug): median 50 cm (range 40 to 75 cm)

Sample size: 31 summary descriptions, 4 full descriptions

Oi horizon:

Color = hue of 5YR, 7.5YR, or 10YR; value moist of 3 to 4; chroma moist of 2 to 6
Texture = peat
Rock fragments = 0%
Reaction = 3.8-6.2

Oe or Oa horizon:

Color = hue of 7.5YRor 10YR; value moist of 2 or 3; chroma moist of 1 to 3
Texture = mucky peat or muck
Rock fragments = 0%
Reaction = 3.8-6.2

Bg horizon:

Color = hue of 2.5Y, 5Y, or N; value moist of 4 or 5; chroma moist of 1 or 2
Texture = silt loam, sandy loam, sand, or gravelly silt loam
Rock fragments = 0-20%
Reaction = 5.6-6.4

Bgf horizon:

Color = hue of 2.5Y, 5Y, or N; value moist of 4 or 5; chroma moist of 1 or 2
Texture = silt loam, sandy loam, sand, or gravelly silt loam
Rock fragments = 0-20%
Reaction = 5.6-7.2

Cryaquepts, loamy substratum

Major taxonomic classes: Histic Pergelic Cryaquepts, Pergelic Cryaquepts
Depth class: very shallow to moderately deep (30 to 70 cm) over permafrost
Drainage class: poorly drained
Permeability: moderate to rapid in the organic mat, moderate in the loamy mineral soil; impermeable in the frozen soil
Position on landscape: slopes of bedrock uplands
Map unit components: Ca1, Ca4, Ck1, Cs1
Parent material: colluvium from loess, glacial till, and weathered bedrock
Slope range: 2 to 20%
Elevation: 122 to 762 m (400 to 2500 feet)

Typical Pedon

Cryaquept = on a 10% slope under open black spruce forest with low shrubs and moss at 366 m (1200 feet) elevation

Oi 0 to 18 cm; dark brown (7.5YR 3/2) slightly decomposed organic matter; common very fine to coarse roots; extremely acid (pH 3.8); clear smooth boundary.
Oa 18 to 26 cm; very dark brown (10YR 2/2) highly decomposed organic matter; few very fine to fine roots; extremely acid (pH 4.0); clear smooth boundary.
Bg 26 to 61 cm; dark gray (N 4/0) loam; weak thick platy structure; friable; slightly sticky and slightly plastic; few very fine to fine roots; 10% gravel; moderately acid (pH 5.6); abrupt smooth boundary.
Bgf 61 to 66 cm; dark gray (5Y 4/1) very gravelly loam; massive; very hard; slightly sticky and slightly plastic; 40% gravel; moderately acid (pH 5.8).

Typical Pedon Location

Map unit in which located: Cs = Colluvial slopes
Location in survey area: 67 deg 02.1 min N, 154 deg 04.0 min W; transect 92DS038, stop 02; Helpmejack Hills south of Kichaiakaka Creek.

Range in Characteristics

Thickness of the organic mat: median 18 cm (range 12 to 38 cm)
Water table (Jul-Aug): occasionally present near the mineral soil surface, and the thawed mineral soil is usually saturated
Depth to frozen soil (Jul-Aug): median 46 cm (range 30 to 70 cm)
Sample size: 81 summary descriptions, 14 full descriptions

Oi horizon:
Color = hue of 7.5YR or 10YR; value moist of 2 to 4; chroma moist of 2 to 6
Texture = peat
Rock fragments = 0%
Reaction = 3.8-4.4
Oe or Oa horizon:
Color = hue of 7.5YR or 10YR; value moist of 2 or 3; chroma moist of 1 or 2

Texture = mucky peat or muck
Rock fragments = 0%
Reaction = 4.0-5.2

Bg horizon:
Color = hue of 10YR, 2.5Y, 5Y, or N; value moist of 3 to 5; chroma moist of 1 or 2
Texture = silt loam, loam, sandy loam; gravelly to extremely gravelly silt loam, loam, or sandy loam
Rock fragments = 0 to 60%
Reaction = 5.2-6.0

Bgf horizon:
Color = hue of 2.5Y or 5Y; value moist of 3 to 5; chroma moist of 1 or 2
Texture = silt loam, loam, sandy loam; gravelly to extremely gravelly silt loam, loam, or sandy loam
Rock fragments = 0 to 60%
Reaction = 5.4-6.0

Cryochrepts, bedrock substratum

Major taxonomic classes: Aquic Cryochrepts, Pergelic Cryochrepts, Typic Cryochrepts: loamy-skeletal, mixed
Depth class: very shallow to moderately deep (0 to 70 cm) over gravel
Drainage class: well to excessively drained
Permeability: rapid in the organic mat, moderate in the mineral soil, moderate to rapid in the gravelly subsoil
Position on landscape: crests, shoulders, and upper slopes of bedrock uplands
Map unit components: Ca2, Ck3, MI1, MI3
Parent material: loess over weathered bedrock or colluvium
Slope range: 0 to 50%
Elevation: 122 to 1036 m (400 to 3400 feet)

Typical Pedon

Cryochrept = on a 10% slope under black spruce forest with low shrubs and lichens at 274 m (900 feet) elevation

Oi 0 to 2 cm; dark grayish brown (10YR 4/2) slightly decomposed organic matter; many very fine to coarse roots; very strongly acid (pH 4.6); clear smooth boundary.

Bw 2 to 40 cm; dark yellowish brown (10YR 4/4) gravelly silt loam; massive, parting to weak fine granular structure; friable; slightly sticky and slightly plastic; few very fine to fine roots; 20% gravel and 5% cobbles; strongly acid (pH 5.4); gradual smooth boundary.

2BCr 40 to 47 cm; dark brown (7.5YR 4/4) extremely gravelly sandy loam; massive; friable; slightly sticky and slightly plastic; 60% gravel and 5% cobbles; strongly acid (pH 5.4).

Typical Pedon Location

Map unit in which located: Ca = Colluvium and Ambler till on bedrock-cored hills

Location in survey area: 66 deg 56.4 min N, 154 deg 35.5 min W; transect 92DS041, stop 08; near the south end of Nutuvukti Lake

Range in Characteristics

Thickness of the organic mat: median 3 cm (range 0 to 8 cm)
Water table (Jul-Aug): none within 150 cm of the surface
Depth to very or extremely gravelly material: median 6 cm (range 0 to 70 cm)
Sample size: 48 summary descriptions, 15 full descriptions

O horizon:
- Color = hue of 7.5YR or 10YR; value moist of 2 to 4; chroma moist of 2
- Texture = peat or muck
- Rock fragments = 0%
- Reaction = 4.0-5.0

A horizon (where present):
- Color = hue of 7.5YR or 10YR; value moist of 2 to 4; chroma moist of 1 or 2
- Texture = silt loam, gravelly loam, very gravelly sandy loam
- Rock fragments = 0 to 50%
- Reaction = 4.4-5.8

Bw horizon:
- Color = hue of 2.5Y or 10YR; value moist of 4; chroma moist of 3 to 6
- Texture = silt loam, loam, sandy loam; gravelly to extremely gravelly silt loam, loam, sandy loam
- Rock fragments = 5 to 70%
- Reaction = 5.4-5.8

2C horizon:
- Color = hue of 2.5Y, 10YR, or 7.5YR; value moist of 3 or 4; chroma moist of 2 to 4
- Texture = extremely gravelly silt loam, loam, or sandy loam
- Rock fragments = 80 to 90%
- Reaction = 5.6-6.0

Cryochrepts, cool

Major taxonomic classes: Aquic Cryochrepts, Typic Cryochrepts
Depth class: moderately to very deep (30 to more than 150 cm) over gravel
Drainage class: moderately well to well drained
Permeability: rapid in the organic mat, moderate in the loamy mineral soil, moderate to rapid in the gravelly subsoil
Position on landscape: crests and upper slopes of moraines and bedrock uplands; terraces
Map unit components: Ad1, Ah3, Ca3, Ck2, Ko4, To1)
Parent material: loess over colluvium, alluvium, glacial till, glacial outwash, or residuum from bedrock
Slope range: 0 to 20 percent
Elevation: 107 to 700 m (350 to 2300 feet)

Typical Pedon

Cryochrept = on a 2% slope under black spruce forest with low shrubs and lichens at 213 m (700 feet) elevation

Oi 0 to 5 cm; dark brown (7.5YR 4/3) slightly decomposed organic matter; many very fine to coarse roots; extremely acid (pH 4.2); clear smooth boundary.

A 5 to 17 cm; dark brown (7.5YR 3/2) silt loam; weak medium subangular blocky structure; friable; slighlty sticky and slightly plastic; common very fine to medium roots; very strongly acid (pH 5.0); gradual smooth boundary.

Bg/A 17 to 95 cm; olive brown (2.5Y 4/4) and very dark grayish brown (10YR 3/2) loam; many large distinct dark grayish brown (2.5Y 4/2) mottles; weak medium platy, parting to moderate fine granular structure; friable; slightly sticky and slightly plastic; 5% gravel; strongly acid (pH 5.4); gradual smooth boundary.

2C 95 to 113 cm; variegated extremely gravelly sand; single grain; loose; nonsticky and nonplastic; 70% gravel; moderately acid (pH 5.6).

Typical Pedon Location

Map unit in which located: Ad = Ambler moraines, dissected
Location in survey area: 66 deg 52.4 min N, 154 deg 38.7 min W; transect 93DS029, stop 04; west of the Kobuk River above Lower Kobuk Canyon

Range in Characteristics

Thickness of the organic mat: median 7 cm (range 0 to 18 cm)
Water table (Jul-Aug): none within 150 cm of the surface
Depth to sand and gravel: median 65 cm (range 30 to more than 150 cm)
Sample size: 46 summary descriptions, 11 full descriptions

Oi horizon:
Color = hue of 7.5YR or 10YR; value moist of 3 or 4; chroma moist of 2 to 8
Texture = peat
Rock fragments = 0%
Reaction = 3.8-4.8

Oe or Oa horizon:
Color = hue of 5YR, 7.5YR, or 10YR; value moist of 2 or 3; chroma moist of 1 or 2
Texture = mucky peat or muck
Rock fragments = 0%
Reaction = 4.2-5.0
A horizon:
Color = hue of 7.5YR or 10YR; value moist of 2 or 3; chroma moist of 1 or 2
Texture = silt loam, mucky silt loam
Rock fragments = 0%
Reaction = 4.4-5.0
Bg or Bw horizon:
Color = hue of 2.5Y or 10YR; value moist of 3 to 6; chroma moist of 2 to 4
Texture = silt loam, loam; gravelly silt loam, loam, or sandy loam
Rock fragments = 0 to 30%
Reaction = 5.4-6.2
2C horizon:
Color = hue of 2.5Y or 10YR; value moist of 4; chroma moist of 2 to 4
Texture = very or extremely gravelly sand, loamy sand, or sandy loam
Rock fragments = 60 to 80%
Reaction = 5.4-6.2

Cryochrepts, shallow

Major taxonomic classes: Aquic Cryochrepts, Typic Cryochrepts, Typic Cryorthods
Depth class: very shallow to moderately deep (0 to 100 cm) over sand and gravel
Drainage class: well to excessively drained
Permeability: rapid in the organic mat, moderate in the loamy surface layer; rapid in the sand and gravel
Position on landscape: stream terraces; crests and slopes of glacial moraines
Map unit components: Ad2, Ae3, Ah2, Aw2, Cs4, Kw3, Nu1, Td1
Parent material: loess over alluvium, glacial outwash, or glacial till
Slope range: 0 to 40%
Elevation: 122 to 457 m (400 to 1500 feet)

Typical Pedon

Cryochrept = on a 25 percent slope under open aspen and black spruce forest with low shrubs and lichens at 320 m (1050 feet) elevation

AO 0 to 3 cm; very dark grayish brown (10YR 3/2) peaty sandy loam; many very fine to coarse roots; extremely acid (pH 4.4); clear wavy boundary.
Bw 3 to 16 cm; dark yellowish brown (10YR 4/4) loam; massive; friable; nonsitcky and nonplastic; few fine roots; moderately acid (pH 5.8); gradual smooth boundary.
BC 16 to 33 cm; olive brown (2.5Y 4/4) and dark eyllowish brown (10YR 4/4) loamy sand; massive; loose; nonsticky and nonplastic; 5% gravel; slightly acid (pH 6.2); clear wavy boundary.
2C1 33 to 60 cm; variegated stratified extremely gravelly sand and sand; single grain; loose;

nonsticky and nonplastic; 50% gravel; slightly acid (pH 6.4); gradual smooth boundary.
2C2 60 to 70 cm; variegated extremely gravelly coarse sand; single grain; loose; nonsticky and nonplastic; 70% gravel; neutral (pH 7.2).

Typical Pedon Location

Map unit in which located: Ah = Ambler moraines, hilly
Location in survey area: 67 deg 02.3 min N, 154 deg 05.5 min W; transect 92DS037, stop 11; south of Kichaiakaka Creek.

Range in Characteristics

Thickness of the organic mat: median 2 cm (range 0 to 8 cm)
Water table (Jul-Aug): none within 150 cm of the surface
Depth to sand and gravel: median 25 cm (range 0 to 100 cm)
Sample size: 102 summary descriptions, 24 full descriptions

O horizon:
- Color = hue of 7.5YR or 10YR; value moist of 2 or 3; chroma moist of 1 or 2
- Texture = peat, mucky peat, or muck
- Rock fragments = 0%
- Reaction = 4.0-5.2

A or AO horizon:
- Color = hue of 10YR; value moist of 2 or 3; chroma moist of 1 to 3
- Texture = peaty or mucky silt loam, loam, sandy loam, or loamy sand
- Rock fragments = 0%
- Reaction = 4.0-5.4

B horizon:
- Color = hue of 7.5YR or 10YR; value moist of 3 or 4; chroma moist of 4 to 6
- Texture = silt loam, sandy loam, loamy sand, or sand; very to extremely gravelly silt loam, sandy loam, loamy sand, or sand
- Rock fragments = 0 to 60%
- Reaction = 5.4-6.2

2C horizon:
- Color = variegated
- Texture = very to extremely gravelly sand or coarse sand
- Rock fragments = 30 to 75%
- Reaction = 5.6-7.2

Cryochrepts, silty

Major taxonomic classes: Aquic Cryochrepts, Typic Cryochrepts, Pergelic Cryochrepts; coarse-silty, mixed
Depth class: deep to very deep (90 to more than 150 cm) over gravel
Drainage class: moderately well to well drained
Permeability: rapid in the organic mat, moderate in the silt loam; rapid in the sand and gravel
Position on landscape: crests and slopes of glacial moraines
Map unit components: Ke2, Ko3
Parent material: loess over glacial outwash
Slope range: 0 to 10 percent
Elevation: 91 to 366 m (300 to 1200 feet)

Typical Pedon

Cryochrept = on a 2% slope under black spruce forest with low shrubs and lichens at 183 m (600 feet) elevation

Oe 0 to 5 cm; dark brown (7.5YR 3/2) moderately decomposed organic matter; many very fine to coarse roots; very strongly acid (pH 4.6); clear smooth boundary.
A 5 to 10 cm; very dark brown (10YR 2/2) silt loam; weak medium granular structure; friable; slightly sticky and slightly plastic; common very fine to coarse roots; strongly acid (pH 5.2); abrupt wavy boundary.
Bw 10 to 95 cm; olive brown (2.5Y 4/4) silt loam; weak thick platy structure; friable; slightly sticky and slightly plastic; few fine roots; 5% gravel; moderately acid (pH 5.8); clear smooth boundary.
BC 95 to 105 cm; olive brown (2.5Y 4/4) very gravelly sandy loam; massive; friable; nonsticky and nonplastic; 40% gravel; slightly acid (pH 6.2).

Typical Pedon Location

Map unit in which located: Ke = Kobuk moraines, ecotonal (lowland tundra-forest)
Location in survey area: 66 deg 47.3 min N, 155 deg 39.3 min W; transect 93DS053, stop 02; between the Kobuk River and Lake Selby

Range in Characteristics

Thickness of the organic mat: median 7 cm (range 3 to 14 cm)
Water table (Jul-Aug): none within 150 cm of the surface
Depth to sand and gravel: median more than 150 cm (range 90 to more than 150 cm)
Sample size: 33 summary descriptions, 7 full descriptions

Oi horizon:
Color = hue of 7.5YR; value moist of 3 or 4; chroma moist of 2 to 4
Texture = peat
Rock fragments = 0%
Reaction = 3.8-4.2
Oe or Oa horizon:
Color = hue of 7.5YR or 10YR; value moist of 2 or 3; chroma moist of 1 or 2

Texture = mucky peat or muck
Rock fragments = 0%
Reaction = 4.0-4.6

A horizon:
Color = hue of 7.5YR or 10YR; value moist of 2 or 3; chroma moist of 2
Texture = silt loam, peaty silt loam
Rock fragments = 0%
Reaction = 5.2-5.8

B horizon:
Color = hue of 2.5Y or 10YR; value moist of 4 or 5; chroma moist of 2 to 4
Texture = silt loam, very fine sandy loam
Rock fragments = 0 to 5%
Reaction = 5.6-6.4

C horizon:
Color = hue of 2.5Y or 10YR; value moist of 3 to 5; chroma moist of 2 to 4
Texture = silt loam, gravelly or very gravelly silt loam, loam sandy loam, or sand
Rock fragments = 0 to 40%
Reaction = 5.4-6.4

Cryofluvents

Major taxonomic classes: Typic Cryofluvents, Aquic Cryofluvents
Depth class: very shallow to moderately deep (20 to more than 100 cm) over gravel
Drainage class: well drained
Permeability: moderate in the loamy surface material and rapid in the sand and gravel
Position on landscape: floodplains
Map unit components: Fc3, Fr2, Fr4
Parent material: alluvium
Slope range: 0 to 2 percent
Elevation: 91 to 274 m (300 to 900 feet)

Typical Pedon

Typic Cryofluvent = on a level slope under balsam poplar woodland with open willow scrub and forbs at 183 m (600 feet) elevation

C/O 0 to 30 cm; very dark grayish brown (2.5Y 3/2) stratified silt loam and fine sand; weak thick platy structure; friable; slightly sticky and slightly plastic; few very fine to coarse roots; neutral (pH 7.2); abrupt smooth boundary.

C1 30 to 70 cm; grayish brown (2.5Y 5/2) sand; single grain; loose; nonsticky and nonplastic; few medium roots; neutral (pH 7.0); clear smooth boundary.

C2 70 to 120 cm; variegated extremely gravelly coarse sand; single grain; loose; nonsticky and nonplastic; 70% gravel; neutral (pH 7.2).

Typical Pedon Location

Map unit in which located: Fr = River flood plains

Location in survey area: 66 deg 55.9 min N, 154 deg 26.7 deg W; transect 92DS059 stop 01; along Kobuk River below Lower Kobuk Canyon

Range in Characteristics

Thickness of the organic mat: median 6 cm (range 0 to 12 cm)
Water table (Jul-Aug): none within 150 cm of the surface
Depth to sand and gravel: median 45 cm (range 20 to 100 cm)
Sample size: 34 summary descriptions, 10 full descriptions

Oi horizon (where present):
- Color = hue of 7.5YR; value moist of 3; chroma moist of 2 to 4
- Texture = peat
- Rock fragments = 0%
- Reaction = 4.8-6.2

Oe horizon (where present):
- Color = hue of 7.5YR or 10YR; value moist of 2 or 3; chroma moist of 2
- Texture = mucky peat
- Rock fragments = 0%
- Reaction = 5.4-6.4

C/O horizon:
- Color = hue of 2.5Y; value moist of 3 or 4; chroma moist of 2
- Texture = stratified silt loam and fine sand
- Rock fragments = 0%
- Reaction = 5.8-7.2

C horizon:
- Color = variegated
- Texture = stratified silt loam and fine sand; coarse sand; extremely gravelly sand or coarse sand;
- Rock fragments = 0 to 80%
- Reaction = 6.4-7.2

Cryofluvents, hillslopes

Major taxonomic classes: Typic Cryofluvents, Aquic Cryofluvents, Pergelic Cryaquents; loamy-skeletal, mixed
Depth class: very shallow to moderately deep (0 to 70 cm) over gravel
Drainage class: moderately well to poorly drained
Permeability: rapid in the organic mat, moderate in the loamy mineral soil
Position on landscape: backslopes of bedrock-cored hills
Map unit component: Cs2
Parent material: colluvium and alluvium
Slope range: 5 to 25%
Elevation: 122 to 762 m (400 to 2500 feet)

Typical Pedon

Cryofluvent = on a 25% slope under white spruce forest with alder understory at 244 m (800 feet) elevation

A/O 0 to 20 cm; dark brown (10YR 3/3) and very dark brown (10YR 2/2) peaty silt loam; massive; many very fine to coarse roots; slightly acid (pH 6.4); clear smooth boundary.
AC 20 to 49 cm; dark brown (10YR 3/3) very gravelly loam; weak coarse granular structure; friable; slightly sticky and slightly plastic; 40% gravel and 10% cobbles; slightly acid (pH 6.4); few very fine to fine roots; gradual smooth boundary.
C 49 to 60 cm; olive brown (2.5Y 4/4) extremely gravelly loam; massive; firm; slightly sticky and slightly plastic; 50% gravel and 20% cobbles; slightly acid (pH 6.2).

Typical Pedon Location

Map unit in which located: Cs = Colluvial slopes
Location in survey area: 66 deg 52.15 min N, 1255 deg 44.5 min W; transect 93DS013, stop 01; west of Lake Selby

Range in Characteristics

Thickness of the organic mat: median 8 cm (range 0 to 14 cm)
Water table (Jul-Aug): commonly present within 50 cm of the surface
Depth to very or extremely gravelly material: median 20 cm (range 0 to 70 cm)
Sample size: 9 summary descriptions, 5 full descriptions

Oe, OA, OC, or A/O horizon:
Color = hue of 5YR, 7.5YR, or 10YR; value moist of 2 or 3; chroma moist of 1 to 3
Texture = peaty silt loam or mucky peat
Rock fragments = 0%
Reaction = 5.0-6.4
CO, C or Bg horizon:
Color = hue of 5Y, 2.5Y, or 10YR; value moist of 3 or 4; chroma moist of 1 to 3
Texture = peaty silt loam, peaty sandy loam, loam, stratified silt and gravelly sand
Rock fragments = 0 to 10%
Reaction = 5.6-6.4

2C horizon:
Color = hue of 2.5Y, 5Y, or 10YR; value moist of 3 or 4; chroma moist of 3 or 4
Texture = very or extremely gravelly silt loam, loam or sandy loam
Rock fragments = 50 to 80%
Reaction = 5.6-6.4

Histosols

Major taxonomic classes: Pergelic Cryofibrists, Pergelic Cryohemists, Pergelic Cryosaprists; dysic
Depth class: shallow (30 to 44 cm) over permafrost
Drainage class: poorly to somewhat poorly drained
Permeability: rapid in the slightly decomposed organic matter, moderate to slow in the moderately to highly decomposed organic matter, impermeable in the frozen organic matter
Position on landscape: palsas and peat plateaus
Map unit components: Ae5, Aw3, Tw4
Parent material: organic matter
Slope range: 0 to 5%
Elevation: 91 to 366 m (300 to 1200 feet)

Typical Pedon

Histosol = on a 0% slope under black spruce woodland over low shrubs and lichens at 213 m (700 feet) elevation

Oi 0 to 23 cm; dark brown (7.5YR 4/4) slightly decomposed organic matter; common fine to coarse roots; extremely acid (pH 4.0)); gradual smooth boundary.
Oa 23 to 44 cm; dark brown (7.5YR 3/2) highly decomposed organic matter; extremely acid (pH 4.0); abrupt smooth boundary.
Oaf 44 to 50 cm; dark brown (7.5YR 3/2) highly decomposed, frozen organic matter; extremely acid (pH 4.0).

Typical Pedon Location

Map unit in which located: Tw = Wet river terraces
Location in survey area: 67 deg 01.0 min N, 154 deg 43.4 min W; transect 92DS028, stop 01; north of Nutuvukti Lake.

Range in Characteristics

Thickness of the organic mat: more than 40 cm
Water table (Jul-Aug): usually absent, but may be present in the lower half of the thawed layer
Depth to frozen soil (Jul-Aug): median 35 cm (range 30 to 44 cm)
Sample size: 14 summary descriptions, 4 full descriptions

Oi horizon:
Color = hue of 7.5YR; value moist of 3 or 4; chroma moist of 4 to 6
Texture = peat
Rock fragments = 0%
Reaction = 3.8-4.2
Oe or Oa horizon:
Color = hue of 7.5YR or 10YR; value moist of 2 or 3; chroma moist of 2
Texture = mucky peat or muck
Rock fragments = 0%
Reaction = 3.8-4.2
Oef or Oaf horizon:
Color = hue of 7.5YR or 10YR; value moist of 2 or 3; chroma moist of 2
Texture = mucky peat or muck
Rock fragments = 0%
Reaction = 3.8-5.2

Histosols, ponded

Major taxonomic classes: Pergelic Cryofibrists, Terric Cryofibrists, Typic Cryofibrists, Typic Cryohemists
Depth class: very deep
Drainage class: very poorly drained
Permeability: high in the slightly decomposed organic matter
Position on landscape: depressions on moraines and stream terraces
Map unit components: Aw4, Kw4, Tw2
Parent material: organic matter
Slope range: 0 to 1 percent
Elevation: 91 to 366 m (300 to 1200 feet)

Typical Pedon

Histosol = on a level slope under open leatherleaf scrub with sedge, cotton sedge, and sphagnum moss at 137 m (450 feet) elevation

Oi 0 to 100 cm; yellowish brown (10YR 5/8), slightly decomposed organic matter; very strongly acid (pH 4.8).
Bg/Oe 100 to 130 cm; dark gray (5Y 5/1) and dark yellowish brown (10YR 3/4) mucky silt loam; slightly sticky and slightly plastic; strongly acid (pH 5.2).

Typical Pedon Location

Map unit in which located: Aw = Ambler moraines, wet
Location in survey area: 66 deg 49.4 min N, 154 deg 56.0 min W; transect 92DS069, stop 05; near confluence of Kobuk and Reed Rivers

Range in Characteristics

Thickness of the organic mat: more than 100 cm
Water table (Jul-Aug): 0 to 5 cm from the surface
Sample size: 19 summary descriptions, 5 full descriptions

Oi horizon:
Color = hue of 7.5YR or 10YR; value moist of 3 to 5; chroma moist of 4 to 8
Texture = peat
Rock fragments = 0%
Reaction = 4.2-5.2
Bg, Bg/Oe, or Oi/Bg horizon:
Color = hue of 5Y; value moist of 4; chroma moist of 1
Texture = mucky silt loam, peaty silt loam, loam, sandy loam
Rock fragments = 0 to 10%
Reaction = 5.2-6.2

Orthents

Major taxonomic classes: Lithic Cryorthents, Typic Cryorthents
Depth class: very shallow (0 to 10 cm) over gravel and cobbles
Drainage class: excessively drained
Permeability: high
Position on landscape: slopes of bedrock uplands
Map unit component: Mh1
Parent material: colluvium, glacial till
Slope range: 25 to 70%
Elevation: 152 to 1408 m (500 to 4620 feet)

Typical Pedon

Orthent = on a 50% slope under black spruce-birch forest with low shrubs and moss at 259 m (850 feet) elevation

OeA 0 to 7 cm; dark brown (7.5YR 3/2) mucky peat; many very fine to coarse roots; extremely acid (pH 4.0); clear wavy boundary.
A/C 7 to 25 cm; dark brown (7.5YR 3/2) and light olive brown (2.5Y 5/4) extremely stoney loam; weak fine granular structure; friable; slightly sticky and slightly plastic; common very fine to coarse roots; gradual broken boundary.
Cr 25 to 37 cm; stones; single grain; loose; nonsticky and nonplastic.

Typical Pedon Location

Map unit in which located: Mh = High mountains
Location in survey area: 66 deg 55.55 min N, 155 deg 36.4 min W; transect 93DS009, stop 01; east of Narvak Lake

Range in Characteristics

Thickness of the organic mat: median 7 cm (range 0 to 15 cm)
Water table (Jul-Aug): none within 150 cm of the surface
Depth to extremely gravely or stoney material: median 0 cm (range 0 to 10 cm)
Sample size: 10 summary descriptions, 6 full descriptions

Oe horizon:
- Color = hue of 7.5YR or 10YR; value moist of 2 or 3; chroma moist of 1 to 4
- Texture = mucky peat
- Rock fragments = 0%
- Reaction = 4.0-6.2

A, A/C, Ab, or AO horizon:
- Color = hue of 7.5YR or 10YR; value moist of 3; chroma moist of 2 or 3
- Texture = silt loam; very to extremely gravelly, cobbly, or stoney silt loam or loam
- Rock fragments = 0 to 80%
- Reaction = 4.4-6.0

C horizon:
- Color = hue of 10YR; value moist of 3 or 4; chroma moist of 3 or 4
- Texture = very to extremely gravelly, cobbly, or stoney sandy loam; or stones
- Rock fragments = 70 to 100%
- Reaction = 5.2-6.0

Pergelic Cryaquepts

Major taxonomic classes: Pergelic Cryaquepts, Histic Pergelic Cryaquepts; loamy, mixed
Depth class: shallow to moderately deep (30 to 90 cm) over permafrost
Drainage class: poorly drained
Permeability: high in the organic mat; moderate in the loamy mineral soil; impermeable in the frozen soil
Position on landscape: floodplains
Map unit components: Fc1, Fr1
Parent material: alluvium
Slope range: 0 to 2 percent
Elevation: 91 to 274 m (300 to 900 feet)

Typical Pedon

Pergelic Cryaquept = on a 0% slope under dwarf black spruce woodland with low shrubs, cottonsedge, and moss at 107 m (350 feet) elevation

Oi 0 to 10 cm; dark brown (7.5YR 3/2) slightly decomposed organic matter; many very fine to medium roots; extremely acid (pH 4.4); clear smooth boundary.

AO 10 to 15 cm; black (10YR 2/1) mucky silt loam; weak coarse granular structure; very friable; slightly sticky and slightly plastic; common very fine to medium roots; moderately acid (pH 5.6); clear smooth boundary.

Bg/O 15 to 30 cm; gray (5Y 5/1) and very dark brown (10YR 2/2) silt loam; common medium

prominent dark yellowish brown (10YR 4/6) mottles; massive; slightly sticky and slightly plastic; slightly acid (pH 6.2); abrupt smooth boundary.

Bg/Of 30 to 35 cm; gray (5Y 5/1) and very dark brown (10YR 2/2) frozen silt loam; common medium prominent dark yellowish brown (10YR 4/6) mottles; massive; very hard; slightly sticky and slightly plastic.

Typical Pedon Location

Map unit in which located: Fr = River flood plains
Location in survey area: 66 deg 45.8 min N, 155 deg 15.2 min W; transect 92DS022 stop 01; along Kobuk River above Bear Island

Range in Characteristics

Thickness of the organic mat: median 10 cm (range 6 to 22 cm)
Water table (Jul-Aug): occasionally present within 80 cm of the surface
Depth to sand and gravel: median 110 cm (range 70 to 200 cm)
Depth to frozen soil (Jul-Aug): median 50 cm (range 30 to 90 cm)
Sample size: 53 summary descriptions, 11 full descriptions

Oi horizon:
- Color = hue of 7.5YR or 10YR; value moist of 2 to 5; chroma moist of 2 to 6
- Texture = peat
- Rock fragments = 0%
- Reaction = 4.0-5.0

Oe, Oe/Bg, or Oe/C horizon:
- Color = hue of 7.5YR or 10YR; value moist of 2 or 3; chroma moist of 1 or 2
- Texture = mucky peat, peaty silt loam
- Rock fragments = 0%
- Reaction = 5.4-6.0

Bg or Bg/O horizon:
- Color = hue of 2.5Y or 5Y; value moist of 3 or 4; chroma moist of 1 or 2
- Texture = silt loam, very fine sandy loam, stratified fine sand and silt
- Rock fragments = 0 to 5%
- Reaction = 5.6-6.6

Bgf or Bg/Of horizon:
- Color = hue of 2.5Y or 5Y; value moist of 3 or 4; chroma moist of 1 or 2
- Texture = silt loam, very fine sandy loam, stratified fine sand and silt
- Rock fragments = 0 to 5%
- Reaction = 5.6-7.2

2Cf horizon:
- Color = variegated
- Texture = stratified sand and extremely gravelly sand
- Rock fragments = 0 to 80%

Pergelic Cryaquepts, silty

Major taxonomic classes: Pergelic Cryaquepts, Pergelic Cryochrepts; coarse-silty, mixed
Depth class: moderately deep to deep (50 to 120 cm) over permafrost
Drainage class: poorly drained
Permeability: high in the slightly decomposed organic matter; moderate in the moderately decomposed organic matter and silt loam
Position on landscape: gentle slopes and crests of glacial moraines
Map unit component: Ke1
Parent material: loess
Slope range: 0 to 5%
Elevation: 91 to 305 m (300 to 1000 feet)

Typical Pedon

Pergelic Cryaquept = on a 3% slope under dwarf black spruce forest with low shrubs, mosses, and lichens at 130 m (425 feet) elevation

Oi 0 to 14 cm; dark brown (7.5YR 3/2) slightly decomposed organic matter; many very fine to coarse roots; extremely acid (pH 3.8); clear smooth boundary.

A 14 to 31 cm; dark brown (7.5YR 3/2) and black (10YR 2/1) silt loam; massive; friable; slightly sticky and slightly plastic; common very fine to medium roots; strongly acid (pH 5.0); clear broken boundary.

Bg/A 31 to 64 cm; dark grayish brown (2.5Y 4/2) and very dark grayish brown (10YR 3/2) silt loam; friable; nonsticky and nonplastic; few very fine to fine roots; moderately acid (pH 5.6); abrupt smooth boundary.

Bgf 64 to 74 cm; dark grayish brown (2.5Y 4/2) and olive brown (2.5Y 4/4) silt loam; massive; very firm; nonsticky and nonplastic; moderately acid (pH 5.8).

Typical Pedon Location

Map unit in which located: Ke = Kobuk moraines, ecotonal (lowland tundra-forest)
Location in survey area: 66 deg 45.6 min N, 155 deg 41.3 min W; transect 93DS055, stop 03; south of the Kobuk River, east of the mouth of the Selby River

Range in Characteristics

Thickness of the organic mat: median 8 cm (range 5 to 18 cm)
Water table (Jul-Aug): none, but the thawed mineral soil is usually saturated and thixotropic
Depth to frozen soil (Jul-Aug): median 90 cm (range 50 to 120 cm)
Sample size: 23 summary descriptions, 6 full descriptions

Oi horizon:
- Color = hue of 7.5YR; value moist of 3; chroma moist of 2
- Texture = peat
- Rock fragments = 0%
- Reaction = 3.8-4.4

Oe or Oa horizon (where present):
- Color = hue of 5YR, 7.5YR, or 10YR; value moist of 2 or 3; chroma moist of 1 or 2

Texture = mucky peat or muck
Rock fragments = 0%
Reaction = 4.4-5.0

A horizon:
Color = hue of 7.5YR or 10YR; value moist of 2 or 3; chroma moist of 1 or 2
Texture = silt loam
Rock fragments = 0%
Reaction = 5.0-5.4

Bg, Bw, or BC horizon:
Color = hue of 5Y or 2.5Y; value moist of 3 to 5; chroma moist of 2 to 4
Texture = silt loam, very fine sandy loam
Rock fragments = 0 to 10%
Reaction = 5.6-6.4

Bgf or Cf horizon:
Color = hue of 2.5Y; value moist of 4; chroma moist of 2 to 4
Texture = silt loam, very fine sandy loam
Rock fragments = 0 to 10%
Reaction = 5.8-6.4

Typic Cryaquents

Major taxonomic classes: Typic Cryaquents, Typic Cryaquepts
Depth class: shallow to deep (25 to 110 cm) over sand and gravel
Drainage class: poorly drained
Permeability: moderate in the loamy mineral soil, rapid in the sand and gravel
Position on landscape: depressions and channels on floodplains
Map unit components: Fc2, Fr5
Parent material: alluvium
Slope range: 0 to 2%
Elevation: 91 to 274 m (300 to 900 feet)

Typical Pedon

Typic Cryaquent = on a 0% slope under sedge and horsetail at 183 m (600 feet) elevation

A 0 to 3 cm; very dark brown (10YR 2/2) peaty silt loam; massive; friable; slightly sticky and slightly plastic; many very fine roots; strongly acid (pH 5.4); abrupt wavy boundary.

Bg1 3 to 65 cm; dark gray (5Y 4/1) peaty silt loam; massive; friable; slightly sticky and slightly plastic; common very fine to coarse roots; slightly acid (pH 6.4); gradual smooth boundary.

Bg2 65 to 80 cm; dark gray (5Y 4/1) fine sandy loam; massive; friable; slightly sticky and slightly plastic; slightly acid (pH 6.4); gradual smooth boundary.

2Bg 80 to 110 cm; dark gray (5Y 4/1) very gravelly coarse sand; single grain; loose; nonsticky and nonplastic; 40% gravel; neutral (pH 7.0).

Typical Pedon Location

Map unit in which located: Fc = Creek flood plains
Location in survey area: 66 deg 57.4 min N, 154 deg 26.0 min W; transect 93DS023, stop 04; west of the Kobuk River near the Upper Kobuk Canyon

Range in Characteristics

Thickness of the organic mat: median 10 cm (range 0 to 30 cm)
Water table (Jul-Aug): often present within 70 cm of the surface
Depth to sand and gravel: median 60 cm (range 25 to 110 cm)
Sample size: 22 summary descriptions, 6 full descriptions

O horizon (where present):
- Color = hue of 7.5YR or 10YR; value moist of 2 to 4; chroma moist of 2 to 4
- Texture = peat or muck
- Rock fragments = 0%
- Reaction = 4.8-6.0

A horizon:
- Color = hue of 10YR; value moist of 2; chroma moist of 1 or 2
- Texture = mucky or peaty silt loam
- Rock fragments = 0%
- Reaction = 5.4

Bg horizon:
- Color = hue of 5Y, 2.5Y, or 10YR; value moist of 3 or 4; chroma moist of 1 or 2
- Texture = stratified silt and fine sand
- Rock fragments = 0%
- Reaction = 5.4-6.4

2C or 2Bg horizon:
- Color = variegated
- Texture = sand, coarse sand; very or extremely gravelly sand or coarse sand
- Rock fragments = 0 to 70%
- Reaction = 5.6-7.0

Typic Cryochrepts, loamy-skeletal

Major taxonomic class: Typic Cryochrepts, loamy-skeletal, mixed
Depth class: very shallow to moderately deep (0 to 50 cm) over gravel
Drainage class: well drained
Permeability: rapid in the organic mat, moderate in the loamy surface soil, high in the gravelly subsoil
Position on landscape: slopes of bedrock uplands
Map unit components: Cs3, MI2
Parent material: colluvium
Slope range: 8 to 55 percent
Elevation: 122 to 1036 m (400 to 3400 feet)

Typical Pedon

Typic Cryochrept, loamy-skeletal=on a 12% slope under black spruce forest with low shrubs and moss at 236 m (775 feet) elevation

Oi 0 to 18 cm; dark brown (7.5YR 3/2) slightly decomposed organic matter; many very fine to coarse roots; very strongly acid (pH 4.0); clear smooth boundary.

A 18 to 30 cm; dark brown (7.5YR 3/2) mucky loam; massive; friable; slightly sticky and slightly plastic; few very fine to fine roots; strongly acid (pH 5.2); clear smooth boundary.

Bw 30 to 93 cm; dark yellowish brown (10YR 4/4) extremely gravelly sandy loam; weak fine granular structure; friable; nonsticky and nonplastic; 60% gravel; strongly acid (pH 5.4).

Typical Pedon Location

Map unit in which located: Cs=Colluvial slopes
Location in survey area: 66 deg 44.0 min N, 155 deg 40.1 min W; transect 93DS057, stop 03; south of the Kobuk River near the western boundary of the Preserve

Range in Characteristics

Thickness of the organic mat: median 12 cm (range 6 to 22 cm)
Water table (Jul-Aug): none within 150 cm of the surface
Depth to very or extremely gravelly material: median 10 cm (range 0 to 50 cm)
Sample size: 23 summary descriptions, 5 full descriptions

Oi horizon:
- Color=hue of 7.5YR; value moist of 3; chroma moist of 2 to 4
- Texture=peat
- Rock fragments=0%
- Reaction=4.0-4.6

Oe horizon (where present):
- Color=hue of 7.5YR; value moist of 3; chroma moist of 2
- Texture=mucky peat
- Rock fragments=0%

Reaction = 4.2-5.2

A horizon:

Color = hue of 7.5YR or 10YR; value moist of 2 or 3; chroma moist of 2
Texture = loam, mucky loam, mucky silt loam
Rock fragments = 0 to 5%
Reaction = 4.8-5.6

Bw horizon:

Color = hue of 10YR; value moist of 3 or 4; chroma moist of 3 or 4
Texture = loam, sandy loam; gravelly to extremely gravelly loam or sandy loam
Rock fragments = 10 to 80%
Reaction = 5.2-5.8

C horizon:

Color = variegated or hue of 2.5Y; value moist of 4; chroma moist of 4
Texture = very to extremely gravelly loam or sandy loam
Rock fragments = 50 to 95%
Reaction = 5.8

Typic Cryorthents

Major taxonomic class: Typic Cryorthents, sandy-skeletal, mixed
Depth class: very shallow (0 to 7 cm) over gravel
Drainage class: excessively drained
Permeability: moderate in the loamy surface material (where present), rapid in the sand and gravel
Position on landscape: floodplains
Map unit component: Fr3
Parent material: alluvium
Slope range: 0 to 2%
Elevation: 91 to 213 m (300 to 700 feet)

Typical Pedon

Typic Cryorthent = on a 0% slope under sparse tall shrubs, grasses, and forbs at 107 m (350 feet) elevation

C 0 to 30 cm; variegated extremely gravelly coarse sand; single grain; loose; nonsticky and nonplastic; 50% gravel and 20% cobbles; neutral (pH 6.6).

Typical Pedon Location

Map unit in which located: Fr = River flood plains
Location in survey area: 66 deg 45.7 min N, 155 deg 30.7 min W; transect 93DS050, stop 01; on a gravel bar of the Kobuk River midway between Bear Island and the western boundary of the Preserve.

Range in Characteristics

Thickness of the organic mat: 0 cm
Water table (Jul-Aug): none within 100 cm of the surface
Depth to sand and gravel: median 0 cm (range 0 to 7 cm)
Sample size: 5 summary descriptions, 1 full description

C1 horizon (where present):
- Color = hue of 2.5Y; value moist of 4; chroma moist of 2
- Texture = stratified silt and fine sand
- Rock fragments = 0%

C horizon:
- Color = variegated
- Texture = extremely gravelly sand or coarse sand
- Rock fragments = 60 to 90%

Chapter 7: Vegetation Site Type Descriptions

Alpine small stream flood plains

Structure: closed tall scrub/moss
Major taxa: *Alnus crispa, Salix planifolia, Hylocomium splendens, Rhytidiadelphus triquestrus*
Setting: Narrow band along creeks in valleys above treeline
Map unit components: Mh1
Soils: Orthents (Chapter 6)
Succession: Unknown; rarely burns.
Comment: Nutrient-demanding vegetation of deciduous shrubs and forbs is maintained due to moisture and nutrient inputs by the creek.

Vegetation and ground cover summary *(+ indicates 0-1% cover; N - sample size)*

NAME	COVER, %
Litter	63
Rock	3
Soil	3
Water	15
SHRUBS	
Alnus crispa	38
Ribes triste	15
Salix planifolia var. pulchra	63
Spiraea beauverdiana	3
Vaccinium uliginosum	3
Vaccinium vitis-idaea	+
GRAMINOIDS	
Agrostis spp.	3
Carex spp.	3
FORBS	
Aconitum delphinifolium	3
Dodecatheon frigidum	3
Linnaea borealis	3
Lycopodium annotinum	15
Polemonium acutiflorum	+
Saxifraga punctata	3
Sedum rosea spp. integrifolium	+
Stellaria spp.	+
Valeriana capitata	+
unknown forb	+

NAME	COVER, %
MOSSES	
moss (total)	38
Hylocomium splendens	15
Rhytidiadelphus triquestrus	15
unknown moss	+
LICHENS	
lichen (total)	+
Peltigera spp.	+
arboreal crustose lichens	+
N	1

Alpine tundra

Structure: open low or dwarf scrub/lichens
Major taxa: *Betula glandulosa, Ledum palustre, Loiseleura procumbens, Cladina spp.*
Setting: Mountains crests and upper slopes
Map unit components: Mh1, Ml3
Soils: Cryochrepts, bedrock substratum; Orthents (Chapter 6)
Succession: Unknown due to rarity of fires.
Comment: This site type includes a variety of wetness conditions, though generally dry. Scattered small trees and various forest shrubs (*Betula glandulosa, Vaccinium uliginosum, Ledum palustre*) are present because these sites are generally not far above treeline. The surface organic layer is thin (due to the near absence of mosses), allowing a rich assemblage of forbs and grasses that prefer mineral soil to grow. The lichen flora is also rich with fruticose tundra species.

Vegetation and ground cover summary *(const - constancy; % of sample stands where present; cover - mean percent cover in stands where present; N - sample size)*

NAME	CONST/COVER
Litter	100/4
Rock	100/47
Soil	100/5
TREES	
Picea glauca	63/2
Picea mariana	13/3
SHRUBS	
Alnus crispa	13/3
Arctostaphylos alpina	50/6
Arctostaphylos rubra	13/3
Betula glandulosa	75/23
Betula nana	13/1
Cassiope tetragona	63/13
Dryas octopetala	25/9
Empetrum nigrum	88/1
Juniperus communis	38/11
Ledum palustre	88/13
Loiseleuria procumbens	75/13
Salix phlebophylla	25/9
Spiraea beauverdiana	63/8
Vaccinium uliginosum	88/11
Vaccinium vitis-idaea	63/7

NAME	CONST/COVER
GRAMINOIDS	
Calamagrostis canadensis	13/15
Calamagrostis purpurascens	13/1
Carex spp.	88/3
Festuca altaica	75/4
Hierochloe alpina	63/1
Luzula confusa	50/1
FORBS	
Anemone narcissiflora	63/1
Antennaria friesiana	25/1
Arnica frigida	25/2
Artemisia arctica	38/6
Bupleurum triradiatum	25/2
Campanula lasiocarpa	25/1
Castilleja spp.	13/1
Cystopteris fragilis	13/1
Dryopteris fragrans	13/1
Gentiana glauca	25/1
Linnaea borealis	13/1
Lupinus arcticus	13/3
Lycopodium alpinum	25/2
Lycopodium annotinum	13/3
Lycopodium clavatum	13/1
Lycopodium complanatum	13/1
Lycopodium selago	25/1
Minuartia arctica	38/2
Oxytropis spp.	13/3
Pedicularis kanei	25/2
Pedicularis labradorica	38/2
Pedicularis spp.	13/1
Polemonium boreale	13/3
Potentilla vahliana	13/1
Tofieldia pusilla	13/1
unknown forb	38/2
MOSSES	
moss (total)	100/3
Dicranum spp.	63/1
Drepanocladus spp.	25/1
Polytrichum spp.	75/2
Racomitrium lanuginosum	38/3
unknown moss	38/2

NAME	CONST/COVER
LICHENS	
lichen (total)	88/77
Alectoria ochroleuca	63/2
Cetraria (dark color)	63/1
Cetraria cucullata	38/2
Cetraria islandica	38/3
Cetraria nivalis	88/6
Cladina mitis	13/1
Cladina rangiferina	75/15
Cladina stellaris	88/34
Cladonia spp.	100/2
Dactylina spp.	26/1
Masonhalea richardsonii	13/1
Peltigera spp.	13/1
Pseudephebe spp.	25/9
Stereocaulon spp.	50/9
Thamnolia spp.	50/2
soil crustose lichens	100/36
unknown lichen	13/3
N	8

Avalanche tracks

Structure: tall scrub/low scrub/(grass)/(moss)
Major taxa: *Alnus crispa, Vaccinium uliginosum, Calamagrostis canadensis*
Setting: Steep slopes of high mountains
Map unit components: Mh1
Soils: Orthents (Chapter 6)
Succession: Succession to forest is prevented by frequent avalanches. *Picea mariana, Picea glauca,* and *Betula papyrifera* are usually present and occasionally reach tree size where avalanches are less frequent. Fires are rare.
Comment: Major plants are those able to avoid mechanical damage caused by avalanches: *Alnus crispa* (which lays downslope when hit by avalanches), low shrubs (mainly *Vaccinium uliginosum*), and herbs. The northwest-facing stand is moist and has a substantial moss cover, while the other stands are drier and support a variety of forbs that prefer mineral soil.

Vegetation and ground cover summary *(NW, SE, E - single sample stands with northwest, southeast, and east slope aspects; + indicates 0-1% cover; dash indicates not present; N - sample size)*

NAME	COVER, %		
	NW	SE	E
Litter	38	63	63
Rock	3	15	+
Soil	+	15	3
Water	3	0	0
TREES			
Betula papyrifera	3	3	15
Picea glauca	-	+	+
Picea mariana	15	-	-
SHRUBS			
Alnus crispa	15	63	38
Betula glandulosa	15	-	-
Betula glandulosa X B. papyrifera	3	-	-
Empetrum nigrum	-	-	3
Juniperus communis	-	3	3
Ledum palustre	+	-	15
Ribes triste	-	3	-
Spiraea beauverdiana	15	3	15
Vaccinium uliginosum	88	3	88
Vaccinium vitis-idaea	+	+	3
GRAMINOIDS			
Calamagrostis canadensis	+	38	3

NAME	COVER, %		
	NW	SE	E
FORBS			
Aconitum delphinifolium	-	3	-
Artemisia arctica	-	+	3
Campanula lasiocarpa	-	+	-
Dryopteris fragrans	-	+	-
Epilobium angustifolium	-	+	-
Linnaea borealis	-	3	3
Lycopodium annotinum	-	-	3
Polemonium acutiflorum	-	3	-
Saxifraga bronchialis	-	+	-
Saxifraga reflexa	-	+	-
Selaginella sibirica	-	3	-
MOSSES			
moss (total)	63	3	15
liverwort	+	-	-
Aulocomnium palustre	+	-	-
Aulocomnium turgidum	+	-	-
Dicranum spp.	3	+	-
Drepanocladus spp.	15	+	-
Hylocomium splendens	15	+	3
Pleurozium schreberi	3	-	-
Polytrichum spp.	-	+	3
Ptilium crista-castrensis	3	-	-
Rhizomnium spp.	+	-	-
Rhytidium rugosum	-	+	-
Sphagnum spp.	15	-	-
unknown moss	-	+	3
LICHENS			
lichen (total)	3	15	15
Cetraria cucullata	+	-	-
Cladina mitis	+	+	+
Cladina rangiferina	+	+	3
Cladina stellaris	+	-	3
Cladonia spp.	-	3	3
Stereocaulon spp.	-	+	-
arboreal crustose lichens	+	-	-
soil crustose lichens	+	15	+
N	1	1	1

Burn thaw-susceptible terraces and uplands

Structure: needleleaf open forest or woodland/(open tall scrub)/low scrub/mosses and lichens

Major taxa: *Picea mariana, Betula glandulosa, Ledum palustre, Vaccinium uliginosum, Polytrichum spp., Cladonia spp.*

Setting: Upper slopes and crests of moraines and bedrock uplands; terraces

Map unit components: Ad1, Ah3, Ca3, Ca4, Ck2, Ko4, To1

Soils: Cryochrepts, cool; Cryaquepts, loamy substratum (Chapter 6)

Succession: Vascular plants resprout or reseed quickly, reaching former cover within several decades after fire. *Polytrichum spp.* and *Cladonia spp.* dominate the ground cover after fire. Fruticose lichens increase gradually over the first century or more (initial high post-fire lichen cover is due to crustose soil lichens). *Sphagnum spp.* and *Rubus chamaemorus* increase later as permafrost table rises, wetness increases, and rooting zone becomes more acidic.

Comment: Late successional stages are reached infrequently due to recurrence of fires. Cover by *Salix* and *Populus* (i.e., abundance of moose browse) is rather low at all successional stages. The "> 100 yr" column below contains late-successional stage stands with permafrost that were judged by landscape position and soil properties to be susceptible to deep thaw after burning. Some areas of site type "Frozen moraines and terraces, forested" could also convert to this site type by severe fire.

Vegetation and ground cover summary *(const - constancy, % of sample stands where present; cover - mean percent cover in stands where present; 10-50, > 100 - years since fire; dash indicates not present; N - sample size)*

NAME	CONST/COVER	
	10-50 yr	>100 yr
Litter	100/25	100/12
Rock	-	50/1
Soil	100/4	100/2
TREES		
Betula papyrifera	18/3	25/3
Betula papyrifera X B. glandulosa	9/1	-
Picea glauca	9/3	-
Picea mariana	100/31	100/27
Populus tremuloides	55/15	-
SHRUBS		
Alnus crispa	-	50/15
Andromeda polifolia	9/3	-
Betula glandulosa	91/36	100/21
Betula glandulosa X B. papyrifera	9/1	-
Chamaedaphne calyculata	-	25/15
Empetrum nigrum	45/3	100/9
Ledum palustre	100/41	100/33
Loiseleuria procumbens	27/6	25/3
Oxycoccus microcarpus	-	25/3

NAME	CONST/COVER	
	10-50 yr	>100 yr
SHRUBS (cont)		
Salix glauca	45/8	-
Salix planifolia X S. glauca	-	25/15
Salix planifolia var. pulchra	36/9	50/15
Spiraea beauverdiana	36/12	25/15
Vaccinium uliginosum	100/41	100/39
Vaccinium vitis-idaea	100/13	100/24
GRAMINOIDS		
Calamagrostis canadensis	18/1	25/3
Carex bigelowii	64/9	75/19
Carex spp.	27/2	-
Eriophorum vaginatum	-	25/3
unknown grass	9/3	-
FORBS		
Epilobium angustifolium	36/2	-
Equisetum arvense	9/3	-
Equisetum sylvaticum	82/13	50/33
Geocaulon lividum	9/1	-
Lupinus arcticus	9/3	-
Lycopodium annotinum	36/2	25/15
Lycopodium complanatum	27/2	-
Petasites frigidus	18/1	-
Rubus arcticus	9/1	-
Rubus chamaemorus	27/7	100/24
MOSSES		
moss (total)	100/53	100/57
Aulocomnium palustre	9/1	25/1
Dicranum spp.	27/14	75/2
Drepanocladus spp.	27/3	-
Hylocomium splendens	27/15	50/15
Pleurozium schreberi	36/11	100/14
Polytrichum spp.	100/47	75/7
Sphagnum spp.	27/2	100/27
unknown moss	45/5	-

NAME	CONST/COVER	
	10-50 yr	>100 yr
LICHENS		
lichen (total)	100/38	100/57
Bryoria spp.	9/15	100/6
Cetraria (dark color)	45/2	75/3
Cetraria cucullata	18/1	50/2
Cetraria nivalis	18/1	-
Cladina mitis	9/3	50/9
Cladina rangiferina	55/4	100/21
Cladina stellaris	64/9	100/21
Cladonia spp.	100/19	100/12
Nephroma arcticum	82/7	75/7
Peltigera spp.	73/4	25/1
Stereocaulon spp.	9/1	25/3
arboreal crustose lichens	27/2	100/2
soil crustose lichens	64/7	50/2
N	11	4

Dry crests and upper slopes of low mountains (forest and scrub)

Structure: (needleleaf or mixed, open forest or woodland)/(open tall scrub)/low scrub/(lichens)

Major taxa: *Picea glauca, Picea mariana, Betula papyrifera, Alnus crispa, Betula glandulosa, Ledum palustre, Vaccinium uliginosum, Cladina spp.*

Setting: Crests, shoulders, and upper slopes of bedrock uplands, near treeline or below

Map unit components: MI1

Soils: Cryochrepts, bedrock substratum (Chapter 6)

Succession: Vascular plants resprout or reseed rapidly after fire and reach former cover within a few decades. *Polytrichum* moss is the dominant groundcover a few decades after fire, while *Cladina* lichens increase gradually over a century or more.

Comment: The tree stratum is rather sparse due to the cold conditions near treeline and perhaps droughtiness also. Species are mainly dry to mesic forest plants (similar to those of "Dry soils, terraces and uplands"), with some typically alpine plants (see "Alpine tundra"). Droughty conditions are favorable to fruticose lichen development.

Vegetation and ground cover summary *(const - constancy, % of sample stands where present; cover - mean percent cover in stands where present; 10-50, >50 - years since fire; dash indicates not present; N - sample size)*

NAME	CONST/COVER	
	10-50 yr	>50 yr
Litter	100/15	100/23
Rock	100/9	83/15
Soil	100/2	100/4
TREES		
Betula papyrifera	50/3	50/15
Betula papyrifera X B. glandulosa	-	17/15
Picea glauca	100/15	67/9
Picea mariana	50/15	67/12
Populus tremuloides	100/27	17/15
SHRUBS		
Alnus crispa	50/38	50/7
Andromeda polifolia	-	17/3
Arctostaphylos rubra	-	17/3
Betula glandulosa	100/38	83/31
Betula glandulosa X B. papyrifera	-	17/15
Empetrum nigrum	100/9	100/23
Juniperus communis	50/3	17/3
Ledum palustre	100/15	100/23
Loiseleuria procumbens	50/15	33/3
Ribes triste	50/3	-
Rosa acicularis	-	17/3

NAME	CONST/COVER	
	10-50 yr	>50 yr
SHRUBS (cont)		
Salix glauca	50/15	33/3
Salix lanata ssp. richardsonii	50/15	-
Salix planifolia var. pulchra	100/9	33/3
Salix polaris	50/3	-
Spiraea beauverdiana	100/3	50/3
Vaccinium uliginosum	100/15	100/27
Vaccinium vitis-idaea	100/15	100/11
GRAMINOIDS		
Festuca altaica	50/3	-
Hierochloe alpina	-	17/3
Luzula multiflora	-	17/3
unknown grass	50/3	33/3
FORBS		
Anemone narcissiflora	-	17/3
Antennaria friesiana	-	17/3
Artemisia arctica	50/15	17/3
Cornus canadensis	50/15	33/3
Dryopteris dilatata	-	17/3
Dryopteris fragrans	-	50/2
Epilobium angustifolium	100/8	50/3
Geocaulon lividum	50/3	33/9
Linnaea borealis	-	17/3
Lupinus arcticus	50/15	-
Lycopodium annotinum	50/1	17/3
Lycopodium clavatum	50/15	-
Lycopodium complanatum	100/2	33/9
Lycopodium obscurum var. dendroideum	50/3	17/3
Minuartia arctica	-	17/1
Pedicularis labradorica	50/3	17/3
Polygonum alaskanum	50/1	33/3
Rubus chamaemorus	50/1	-
Solidago multiradiata	50/1	-
unknown forb	-	17/1

NAME	CONST/COVER	
	10-50 yr	>50 yr
MOSSES		
moss (total)	100/52	83/15
liverwort	50/1	-
Dicranum spp.	50/1	67/6
Drepanocladus spp.	50/1	17/1
Hylocomium splendens	-	50/7
Pleurozium schreberi	50/3	67/6
Polytrichum spp.	100/46	67/9
Racomitrium lanuginosum	-	17/1
Rhytidium rugosum	-	17/1
unknown moss	-	33/9
LICHENS		
lichen (total)	100/27	100/76
Bryoria spp.	50/3	67/6
Cetraria (dark color)	50/1	83/2
Cetraria cucullata	-	50/2
Cetraria nivalis	-	50/2
Cladina mitis	100/3	33/2
Cladina rangiferina	50/3	83/20
Cladina stellaris	100/3	100/39
Cladonia spp.	100/9	100/9
Nephroma arcticum	100/2	50/2
Peltigera spp.	100/2	50/2
Stereocaulon spp.	100/9	67/11
Usnea spp.	-	17/1
arboreal crustose lichens	-	83/2
soil crustose lichens	100/15	67/6
N	2	6

Dry flood plain, small streams

Structure: open needleleaf or mixed forest/tall or low scrub/moss

Major taxa: *Picea glauca, Betula papyrifera, Alnus crispa, Rosa acicularis, Vaccinium vitis-idaea, Hylocomium splendens*

Setting: Flood plains of small streams

Map unit components: Fc3

Soils: Cryofluvents (Chapter 6)

Succession: Flood effects should maintain nutrient-demanding vegetation on most sites. An increase in ericaceous shrubs and decrease in deciduous trees, shrubs, and herbs is likely if flooding becomes rare. Post-fire succession is unknown due to small sample size and rarity of fires on this type.

Comment: This type is poorly defined due to the small sample size. It generally resembles the dry flood plain sites of large rivers but is less isolated from surrounding vegetation (because it occurs in narrow bodies); hence plants not necessarily typical of flood plains (e.g. *Betula papyrifera*) are more likely to be present. Rather diverse shrub and herb layers are present due to nutrient additions by flooding. Conversion of this site type to the "Frozen flood plain of creeks" type is possible with plant succession and organic mat accumulation.

Vegetation and ground cover summary *(+ indicates 0-1% cover; N - sample size)*

NAME	COVER, %
Litter	15
Rock	0
Soil	0
Water	0
TREES	
Betula papyrifera	38
Picea glauca	15
SHRUBS	
Alnus crispa	15
Ledum palustre	+
Ribes triste	3
Rosa acicularis	38
Salix glauca	3
Spiraea beauverdiana	3
Vaccinium uliginosum	3
Vaccinium vitis-idaea	38
GRAMINOIDS	
Calamagrostis canadensis	15

NAME	COVER, %
FORBS	
Epilobium angustifolium	+
Equisetum pratense	15
Linnaea borealis	3
Mertensia paniculata	15
Rubus arcticus	3
MOSSES	
moss (total)	88
Dicranum spp.	15
Drepanocladus spp.	3
Hylocomium splendens	88
Polytrichum spp.	3
Ptilium crista-castrensis	3
Sphagnum spp.	3
LICHENS	
lichen (total)	15
Cladina rangiferina	3
Cladonia spp.	3
Peltigera spp.	3
Usnea spp.	15
arboreal crustose lichens	3
N	1

Dry, occasionally flooded river flood plain (tall scrub and poplar forest)

Structure: broadleaf or mixed forest, or tall scrub/graminoids or forbs

Major taxa: *Populus balsamifera, Salix alaxensis, Alnus spp., Calamagrostis canadensis, Galium boreale, Mertensia paniculata*

Setting: Low portions of flood plains bordering gravel bars or the river channel

Map unit components: Fr2

Soils: Cryofluvents (Chapter 6)

Succession: Prevented in many areas by flooding and ice scour. If disturbance lessens by a shift in the channel and/or raising of the ground surface by alluvial deposition, forb and tall scrub areas succeed to poplar forest. With time the poplar forest probably evolves toward the vegetation of the "Dry occasionally flooded river flood plain (white spruce/alder forest)" site type. Post-fire succession unknown due to rarity of burns: deciduous vegetation has low flammability.

Comment: A rich flora of deciduous shrubs and forbs is present on the fresh river sediments of these sites. These sediments have a neutral pH (as opposed to the acid conditions on most other sites) and consequent good supply of mineral nutrients. Woody plants are mainly those that can tolerate mechanical disturbance (breakage and burial) by flooding and ice scour: *Salix spp., Alnus spp., Populus balsamifera. P. balsamifera* can assume either shrub or tree form, depending on the degree of disturbance. *Picea glauca* trees are constantly seeded in from adjoining areas but rarely attain tree size due to disturbance.

Vegetation and ground cover summary *(const - constancy, % of sample stands where present; cover - mean percent cover in stands where present; N - sample size)*

NAME	CONST/COVER
Litter	100/68
Rock	33/2
Soil	100/20
TREES	
Picea glauca	100/11
Populus balsamifera	100/51
SHRUBS	
Alnus crispa	83/34
Alnus incana	50/19
Arctostaphylos alpina	17/3
Arctostaphylos rubra	17/3
Ribes triste	50/19
Rosa acicularis	67/21
Salix alaxensis	100/23
Salix lanata ssp. richardsonii	17/3
Salix planifolia var. pulchra	33/3
Shepherdia canadensis	33/3
Vaccinium vitis-idaea	17/1
Viburnum edule	33/63

NAME	CONST/COVER
GRAMINOIDS	
Agropyron spp.	50/23
Agrostis spp.	17/38
Calamagrostis canadensis	83/37
Hierochloe alpina	17/1
Poa spp.	33/2
FORBS	
Allium schoenoprasum	33/2
Artemisia tilesii	83/8
Aster sibiricus	50/7
Astragalus alpinus	17/1
Boschniakia rossica	17/1
Castilleja caudata	17/3
Castilleja hyperborea	17/1
Cypripedium passerinum	17/1
Epilobium angustifolium	83/8
Equisetum arvense	17/15
Equisetum pratense	50/15
Equisetum scirpoides	17/1
Galium boreale	100/17
Gentiana propinqua	17/3
Hedysarum alpinum	50/15
Iris setosa	17/1
Linnaea borealis	33/1
Lupinus arcticus	17/15
Lycopodium annotinum	17/3
Mertensia paniculata	100/11
Moneses uniflora	17/3
Parnassia palustris	33/3
Pedicularis verticillata	33/2
Petasites frigidus	17/3
Platanthera obtusata	17/3
Polygonum viviparum	17/1
Pyrola asarifolia	17/15
Pyrola grandiflora	17/1
Pyrola secunda	33/2
Rubus arcticus	50/15
Sanguisorba officinalis	67/3
Solidago multiradiata	50/7
Zigadenus elegans	33/2
unknown forb	50/7

NAME	CONST/COVER
MOSSES	
moss (total)	100/21
liverwort	17/1
Aulocomnium palustre	17/1
Dicranum spp.	17/38
Drepanocladus spp	100/7
Hylocomium splendens	17/3
Polytrichum spp.	17/1
unknown moss	100/9
LICHENS	
lichen (total)	83/5
Cladonia spp.	17/3
Peltigera spp.	17/1
Stereocaulon spp.	17/3
arboreal crustose lichens	67/2
soil crustose lichens	17/3
N	6

Dry, occasionally flooded river flood plain (white spruce/alder forest)

Structure: needleleaf open forest or woodland/tall scrub/low scrub/mosses or forbs
Major taxa: *Picea glauca, Alnus crispa, Rosa acicularis, Linnaea borealis, Hylocomium splendens*
Setting: Flood plains of the Kobuk and Reed Rivers
Map unit components: Fr4
Soils: Cryofluvents (Chapter 6)
Succession: Some areas are probably stable, especially those with a thin loamy surface layer (i.e. drier sites) and those with more frequent flooding (which inhibits the formation of a thick organic surface layer). Other areas are evolving into black spruce forest (see the "Rarely flooded river flood plain with permafrost" site). The latter are generally those with a loamy surface layer more than 1 m thick (i.e. moister sites due to better soil water-holding capacity) and less frequent flooding. Here the moss-organic layer gradually thickens, the soil becomes colder, near-surface permafrost becomes established, and the soil becomes wetter. *Picea glauca* and *Alnus crispa* are gradually replaced by *Picea mariana* and low shrubs (ericads and *Betula glandulosa*). Post-fire succession unknown due to rarity of fires: alder has low flammability.
Comment: More acidic conditions in the rooting zone (due to less frequent flood deposition of fresh material) and shade lead to a less diverse understory vegetation on these sites than on "Dry occasionally flooded river flood plain (tall scrub and poplar forest)". A dense moss cover is present, dominated by *Hylocomium splendens* and often including the characteristic flood plain species *Rhytidiadelphus triquestrus*. The vegetation appears from a distance to be dominated by large *Picea glauca* trees, but in fact trees usually form an open superstory over closed *Alnus crispa* scrub. This site type probably forms from site type "Dry, occasionally flooded river flood plain (tall scrub and poplar forest)" by plant succession, accumulation of a surface organic mat, and reduction in flood disturbance by changes in river course or by raising of the ground surface as sediment accumulates.

Vegetation and ground cover summary *(const - constancy, % of sample stands where present; cover - mean percent cover in stands where present; N - sample size)*

NAME	CONST/COVER
Litter	100/48
Soil	100/1
TREES	
Picea glauca	100/34
Populus balsamifera	60/11
SHRUBS	
Alnus crispa	100/73
Alnus incana	20/3
Arctostaphylos rubra	60/7
Chamaedaphne calyculata	20/3
Empetrum nigrum	20/3
Ledum palustre	20/15

NAME	CONST/COVER
SHRUBS (cont)	
Ribes triste	100/8
Rosa acicularis	100/13
Salix alaxensis	40/3
Salix glauca	20/3
Salix planifolia var. pulchra	80/3
Vaccinium uliginosum	60/19
Vaccinium vitis-idaea	60/19
GRAMINOIDS	
Arctagrostis latifolia	20/1
Calamagrostis canadensis	80/9
Carex aquatilis	20/1
Carex spp.	20/1
unknown grass	20/15
FORBS	
Aconitum delphinifolium	40/2
Artemisia tilesii	100/7
Boschniakia rossica	100/1
Epilobium angustifolium	20/3
Equisetum pratense	100/3
Galium boreale	100/7
Geocaulon lividum	60/2
Hedysarum alpinum	20/15
Iris setosa	60/1
Linnaea borealis	100/8
Lupinus arcticus	20/3
Lycopodium annotinum	40/9
Mertensia paniculata	100/5
Moneses uniflora	20/1
Platanthera obtusata	20/1
Polemonium acutiflorum	20/1
Potentilla palustris	20/1
Pyrola asarifolia	60/3
Pyrola grandiflora	40/2
Rubus arcticus	80/6
Rubus chamaemorus	20/1
Sanguisorba officinalis	20/1
Solidago multiradiata	20/1
Wilhelmsia physodes	20/1
unknown forb	20/1

NAME	CONST/COVER
MOSSES	
moss (total)	100/73
liverwort	20/1
Aulocomnium palustre	20/1
Dicranum spp.	20/3
Drepanocladus spp.	40/3
Hylocomium splendens	100/41
Pleurozium schreberi	40/20
Polytrichum spp.	40/3
Rhytidiadelphus triquestrus	80/29
Sphagnum spp.	20/1
Splachnum luteum	20/1
unknown moss	40/2
LICHENS	
lichen	100/13
Bryoria spp.	80/12
Cladina rangiferina	20/1
Cladonia spp.	40/1
Peltigera spp.	80/2
Usnea spp.	100/8
arboreal crustose lichens	100/3
N	5

Dry terraces and uplands (lichen woodland)

Structure: needleleaf or mixed open forest or woodland/low scrub/lichens
Major taxa: *Picea mariana, Populus tremuloides, Ledum palustre, Vaccinium uliginosum, Cladina spp.*
Setting: Crests and upper slopes of moraines and bedrock uplands; terraces
Map unit components: Ad2, Ae3, Ah2, Aw2, Ca2, Ck3, Cs4, Ke2, Ko3, Kw3, Nu1, Td1
Soils: Cryochrepts, shallow; Cryochrepts, silty; Cryochrepts, bedrock substratum (Chapter 6)
Succession: *Corydalis sempervirens* and *Calamagrostis canadensis* are conspicuous but have low cover in the first few years after fire. *Populus tremuloides, Betula glandulosa, Epilobium angustifolium, Polytrichum spp.*, and *Cladonia spp.* peak everal decades after fire and decrease thereafter. The major late-successional vascular plants (*P. mariana, Ledum palustre, V. uliginosum, V. vitis-idaea*) resprout or reseed and reach former cover values within half a century. *Cladina* lichens increase gradually over the first century or more.
Comment: Sites are droughty at all successional stages. Herb flora is poor due to infertile soils. The pulse of nutrients after fire is rather weak and facilitates little change in the species composition. *Picea mariana* is the dominant tree due to its ability to reseed after fire and tolerate infertile soils. *Populus tremuloides* often shows signs of nutrient stress at late successional stages. Sparse tree cover and droughty conditions favor lichens over feathermosses.

Vegetation and ground cover summary *(const - constancy, % of sample stands where present; cover - mean percent cover in stands where present; <10, 10-50, 50-100, >100 - years since fire; dash indicates not present; N - sample size)*

NAME	CONST/COVER			
	<10 yr	10-50 yr	50-100 yr	>100 yr
Litter	100/29	100/31	100/22	100/11
Rock	60/6	50/4	80/3	43/2
Soil	100/48	95/5	100/5	90/6
Water	-	-	-	5/0
TREES				
Betula papyrifera	20/3	40/7	20/15	19/6
Betula papyrifera X B. glandulosa	-	5/3	20/3	-
Picea glauca	-	30/5	40/15	1/2
Picea mariana	80/9	90/22	80/21	100/23
Populus tremuloides	60/6	80/28	60/19	19/18
SHRUBS				
Alnus crispa	-	5/3	-	-
Andromeda polifolia	-	-	-	5/3
Betula glandulosa	80/6	75/25	80/18	95/13
Betula glandulosa X B. papyrifera	-	15/2	20/3	1/9
Cassiope tetragona	-	5/1	-	-
Chamaedaphne calyculata	-	-	-	5/3

NAME	CONST/COVER			
	<10 yr	10-50 yr	50-100 yr	>100 yr
SHRUBS (cont)				
Empetrum nigrum	20/3	80/14	100/17	81/1
Ledum palustre	100/10	95/22	100/33	100/33
Loiseleuria procumbens	60/6	50/10	80/12	52/7
Rosa acicularis	-	5/3	40/2	1/2
Salix glauca	80/3	65/8	100/5	52/6
Salix planifolia X S. glauca	-	10/9	20/3	-
Salix planifolia var. pulchra	-	30/5	20/3	29/7
Salix reticulata	-	5/1	-	-
Spiraea beauverdiana	-	15/7	-	5/3
Vaccinium uliginosum	100/7	100/22	100/38	100/31
Vaccinium vitis-idaea	80/6	100/13	100/15	100/13
GRAMINOIDS				
Calamagrostis canadensis	60/6	10/2	-	14/1
Carex bigelowii	20/3	20/2	-	43/7
Carex spp.	40/1	15/6	60/2	33/8
Eriophorum vaginatum	20/3	-	-	-
Festuca altaica	-	10/9	-	-
Hierochloe alpina	-	-	20/1	-
unknown grass	20/1	30/1	-	5/1
unknown sedge	-	5/1	-	-
FORBS				
Arnica frigida	-	5/1	20/3	-
Cornus canadensis	-	5/3	-	-
Corydalis sempervirens	20/3	-	-	-
Epilobium angustifolium	20/1	40/1	20/1	1/1
Equisetum arvense	-	-	-	5/1
Equisetum sylvaticum	40/9	15/1	-	48/11
Geocaulon lividum	-	20/9	20/3	14/14
Lycopodium alpinum	20/1	5/1	-	-
Lycopodium annotinum	-	15/1	40/2	5/1
Lycopodium clavatum	20/1	15/2	-	-
Lycopodium complanatum	20/1	50/3	40/2	19/3
Lycopodium obscurum var. dendroideum	-	10/3	-	-
Pedicularis labradorica	-	10/1	20/1	-
Rubus chamaemorus	-	5/3	-	14/14

NAME	CONST/COVER			
	< 10 yr	10-50 yr	50-100 yr	> 100 yr
MOSSES				
moss (total)	100/12	100/35	100/20	100/25
liverwort	60/1	-	-	5/1
Aulocomnium palustre	-	15/2	-	-
Dicranum spp.	40/1	55/4	80/6	81/3
Drepanocladus spp.	-	20/2	20/3	-
Hylocomium splendens	20/3	5/3	60/6	43/9
Pleurozium schreberi	20/3	20/6	40/2	62/17
Polytrichum spp.	80/11	100/32	100/10	90/5
Ptilium crista-castrensis	-	-	-	5/1
Rhytidium rugosum	-	-	20/1	-
Sphagnum spp.	-	5/3	-	33/9
Tomenthypnum nitens	20/1	10/1	-	-
unknown moss	20/1	25/2	20/3	33/2
LICHENS				
lichen (total)	100/10	100/41	100/73	100/78
Bryoria spp.	40/3	5/3	40/9	86/8
Cetraria (dark color)	40/1	50/2	100/7	81/4
Cetraria cucullata	40/1	20/2	20/1	62/2
Cetraria islandica	-	-	-	19/2
Cetraria nivalis	20/1	25/2	20/1	24/7
Cladina mitis	-	35/3	60/11	38/9
Cladina rangiferina	20/3	25/5	100/13	100/24
Cladina stellaris	80/2	75/7	100/25	100/42
Cladonia spp.	80/2	95/18	80/21	100/1
Dactylina spp.	-	-	20/3	-
Nephroma arcticum	60/2	70/3	100/8	86/9
Peltigera spp.	20/3	65/8	40/3	62/2
Stereocaulon spp.	60/1	55/5	80/15	33/13
Usnea spp.	-	-	-	24/1
arboreal crustose lichens	40/1	35/1	40/2	90/2
soil crustose lichens	60/2	80/4	80/3	57/2
unknown lichen	40/15	-	-	5/1
N	5	20	5	21

Frozen flood plain of creeks

Structure: open needleleaf or mixed forest/tall scrub/low scrub/moss

Major taxa: *Picea glauca, Betula glandulosa, Alnus crispa, Salix spp., Vaccinium uliginosum, Hylocomium splendens*

Setting: Flood plains of small streams (Beaver Creek, Akpelik Creek, etc.)

Map unit components: Fc1

Soils: Pergelic Cryaquepts (Chapter 6)

Succession: The opposing forces of flooding/alluviation and organic matter accumulation/permafrost formation produce a complex pattern of vegetation change in time and space. Post-fire succession is unknown due to the small sample size and rarity of fires on this type.

Comment: These sites contain plants characteristic of both dry flood plains (*Picea glauca, Ribes triste, Rosa acicularis, Salix spp.*, various forbs) and of acidic, wet soils with permafrost (*Picea mariana, Betula glandulosa,* ericaceous shrubs). The former are present thanks to nutrients input by floods and seed rain from adjacent dry flood plain; the latter are present thanks to the cold wet soil and seed rain from adjacent expanses of unflooded frozen soils. These sites occupy narrow zones of influence of small streams and hence include largely transitional vegetation types. This type may form from site type "Dry flood plain, small streams" by plant succession and accumulation of a surface soil organic mat.

Vegetation and ground cover summary *(const - constancy, % of sample stands where present; cover - mean percent cover in stands where present; N - sample size)*

NAME	CONST/COVER
Litter	100/39
Soil	100/2
Water	25/1
TREES	
Betula papyrifera	50/8
Picea glauca	75/23
Picea mariana	25/15
SHRUBS	
Alnus crispa	75/55
Arctostaphylos rubra	25/3
Betula glandulosa	25/38
Ledum palustre	50/33
Ribes triste	50/9
Rosa acicularis	50/9
Salix alaxensis	25/15
Salix glauca	25/15
Salix lanata ssp. richardsonii	25/15
Salix planifolia var. pulchra	75/11
Spiraea beauverdiana	50/27
Vaccinium uliginosum	100/23
Vaccinium vitis-idaea	100/9

NAME	CONST/COVER
GRAMINOIDS	
Arctagrostis latifolia	25/15
Calamagrostis canadensis	50/9
Carex bigelowii	25/15
Eriophorum vaginatum	25/88
FORBS	
Aconitum delphinifolium	50/1
Boschniakia rossica	25/1
Cornus canadensis	25/15
Equisetum pratense	50/9
Equisetum sylvaticum	25/15
Galium boreale	25/1
Linnaea borealis	50/9
Lycopodium selago	50/2
Mertensia paniculata	50/1
Petasites frigidus	25/3
Potentilla palustris	25/1
Pyrola grandiflora	25/3
Ranunculus lapponicus	25/1
Rubus arcticus	75/7
Rubus chamaemorus	25/3
Saxifraga punctata	50/1
Thalictrum sparsiflorum	50/1
Trientalis europaea	25/1
Valeriana capitata	25/3
Viola epipsila	25/1
unknown forb	25/3
MOSSES	
moss (total)	100/33
Aulocomnium palustre	25/15
Dicranum spp.	75/2
Drepanocladus spp.	75/2
Hylocomium splendens	100/21
Mnium spp.	25/1
Pleurozium schreberi	25/15
Polytrichum spp.	75/2
Ptilium crista-castrensis	50/1
Rhytidiadelphus triquestrus	25/1
Sphagnum spp.	75/6
unknown moss	75/2

NAME	CONST/COVER
LICHENS	
lichen (total)	100/12
Bryoria spp.	50/2
Cladina rangiferina	25/3
Cladina stellaris	25/3
Cladonia spp.	100/3
Nephroma arcticum	25/1
Peltigera spp.	75/1
Usnea spp.	50/8
arboreal crustose lichens	75/2
N	4

Frozen moraines and terraces, forested

Structure: needleleaf open forest or woodland/low scrub/graminoids/moss
Major taxa: *Picea mariana, Ledum palustre, Vaccinium uliginosum, Carex spp., Sphagnum spp.*
Setting: Gentle crests and slopes of moraines; terraces
Map unit components: Ad3, Ae2, Ah1, Ko1, Kw2, To2
Soils: Cryaquepts; Cryaquepts, gravelly substratum (Chapter 6)
Succession: *Picea mariana* trees recover their original cover (though not height) by 50 years after fire. Mosses and lichens increase gradually over the first century or more, except for *Polytrichum spp.*, which peaks several decades after fire. There is essentially no increase in deciduous browse after fire.
Comment: Cold, rather wet, and nutrient-poor conditions lead to dominance of *Picea mariana* trees, ericaceous shrubs, feathermosses, and lichens. Persistence of near-surface permafrost after fires generally favors a weak response of vegetation to fires. However, a severe burn could convert some areas of this site type to "Burn thaw-susceptible terraces and uplands". Also, thermokarst can convert small areas of this type to site type "Thermokarst depressions".

Vegetation and ground cover summary *(const - constancy, % of sample stands where present; cover - mean percent cover in stands where present; <50, >50 - years since fire; dash indicates not present; N - sample size)*

NAME	CONST/COVER	
	<50 yr	>50 yr
Litter	100/28	100/17
Soil	100/11	83/3
Water	14/15	25/2
TREES		
Picea mariana	100/15	100/33
SHRUBS		
Alnus crispa	14/15	17/8
Andromeda polifolia	14/3	8/3
Arctostaphylos rubra	-	17/15
Betula glandulosa	100/25	92/16
Betula glandulosa X B. papyrifera	14/3	-
Chamaedaphne calyculata	43/3	25/10
Empetrum nigrum	43/3	75/6
Ledum palustre	100/49	100/43
Oxycoccus microcarpus	29/2	50/3
Rosa acicularis	-	8/3
Salix glauca	29/15	17/15
Salix lanata ssp. richardsonii	-	17/9
Salix planifolia X S. glauca	-	8/15
Salix planifolia var. pulchra	71/5	42/7
Spiraea beauverdiana	57/6	50/7
Vaccinium uliginosum	100/38	100/40
Vaccinium vitis-idaea	100/18	100/16

NAME	CONST/COVER	
	<50 yr	>50 yr
GRAMINOIDS		
Arctagrostis spp.	-	8/1
Calamagrostis canadensis	71/2	8/15
Carex bigelowii	57/27	67/28
Carex spp.	29/15	33/32
Eriophorum vaginatum	71/17	42/24
unknown grass	-	8/1
unknown sedge	-	8/1
FORBS		
Epilobium angustifolium	29/9	8/1
Equisetum arvense	-	8/3
Equisetum sylvaticum	29/39	42/17
Galium boreale	-	8/1
Geocaulon lividum	14/1	8/15
Lycopodium annotinum	14/1	-
Moneses uniflora	-	8/1
Pedicularis labradorica	-	8/1
Petasites frigidus	-	33/2
Petasites hyperboreus	29/9	8/3
Pyrola secunda	14/1	-
Rubus chamaemorus	86/17	92/17
Rumex arcticus	-	8/3
Saxifraga punctata	-	8/1
unknown forb	-	8/3
MOSSES		
moss (total)	100/59	100/78
liverwort	14/1	8/1
Aulocomnium palustre	14/1	33/3
Dicranum spp.	71/5	50/4
Drepanocladus spp.	14/1	-
Hylocomium splendens	14/3	75/26
Pleurozium schreberi	43/23	75/16
Polytrichum spp.	100/23	83/1
Sphagnum spp.	100/32	100/46
Tomenthypnum nitens	14/3	25/6
unknown moss	14/3	50/1

NAME	CONST/COVER	
	<50 yr	>50 yr
LICHENS		
lichen (total)	100/27	100/45
Bryoria spp.	29/2	92/8
Cetraria (dark color)	57/9	67/6
Cetraria cucullata	14/1	58/3
Cetraria islandica	14/1	-
Cladina mitis	43/2	50/8
Cladina rangiferina	57/6	92/17
Cladina stellaris	71/13	92/18
Cladonia spp.	100/1	100/9
Nephroma arcticum	57/2	83/4
Peltigera spp.	57/2	67/2
Usnea spp.	-	8/1
arboreal crustose lichens	57/1	83/1
soil crustose lichens	57/8	17/2
N	7	12

Frozen terraces, minerotrophic

Structure: low scrub/graminoids/moss

Major taxa: *Betula glandulosa, Salix spp., Vaccinium uliginosum, Calamagrostis canadensis, Sphagnum spp.*

Setting: Stream terraces near mountain footslopes

Map unit components: Tw3

Soils: Cryaquepts, gravelly substratum (Chapter 6)

Succession: Unknown due to rarity of wildfires on this type and small sample size. Wetness prevents succession to forest.

Comment: Rich herb and shrub flora due to nutrient-rich groundwater discharge.

Vegetation and ground cover summary *(const - constancy, % of sample stands where present; cover - mean percent cover in stands where present; N - sample size)*

NAME	CONST/COVER
Litter	100/54
Soil	75/7
Water	75/35
TREES	
Picea glauca	25/3
Picea mariana	50/3
SHRUBS	
Alnus crispa	25/3
Andromeda polifolia	25/1
Betula glandulosa	75/23
Chamaedaphne calyculata	50/27
Ledum palustre	25/63
Myrica gale	25/15
Oxycoccus microcarpus	25/1
Salix fuscescens	75/23
Salix glauca	25/3
Salix planifolia var. pulchra	75/42
Vaccinium uliginosum	100/30
Vaccinium vitis-idaea	25/15
GRAMINOIDS	
Calamagrostis canadensis	100/39
Carex aquatilis	50/21
Carex bigelowii	25/3
Carex spp.	25/1
Eriophorum angustifolium	25/3
Eriophorum vaginatum	25/15

NAME	CONST/COVER
FORBS	
Epilobium angustifolium	25/3
Iris setosa	25/1
Lycopodium annotinum	25/3
Petasites frigidus	25/3
Potentilla palustris	50/3
Pyrola asarifolia	25/1
Ranunculus lapponicus	25/3
Rubus arcticus	25/3
Rubus chamaemorus	50/2
Viola spp.	25/1
unknown forb	50/1
MOSSES	
moss (total)	100/57
Aulocomnium palustre	25/38
Aulocomnium turgidum	25/3
Drepanocladus spp.	25/15
Hylocomium splendens	50/3
Mniumm spp.	25/1
Pleurozium schreberi	25/3
Polytrichum spp.	50/3
Rhizomnium spp.	25/1
Sphagnum spp.	100/24
Tomenthypnum nitens	25/1
unknown moss	50/20
LICHENS	
lichen (total)	75/2
Cetraria (dark color)	25/1
Cetraria cucullata	25/1
Cladonia spp.	25/3
Nephroma arcticum	25/1
Peltigera spp.	25/1
arboreal crustose lichens	25/1
N	4

Gravel bars, frequently flooded

Structure: open tall scrub/graminoids
Major taxa: *Salix alaxensis, Agropyron spp., Artemisia tilesii, Hedysarum alpinum*
Setting: Gravel bars on floodplains of the Kobuk and Reed Rivers
Map unit components: Fr3
Soils: Typic Cryorthents (Chapter 6)
Succession: Prevented under present conditions by disturbance (flooding and ice-scour). If disturbance lessens (through channel migration and/or raising of the surface by alluvial deposition), the vegetation should develop into that of the "Dry occasionally flooded river flood plain (tall scrub and poplar forest)" site type. Post-fire succession is unknown because fires do not occur on this site.
Comment: Vegetation is sparse and dominated by herbs and fast-growing deciduous shrubs adapted to disturbance: breakage by floating debris (mainly ice) and burial by alluvium.

Vegetation and ground cover summary *(const - constancy, % of sample stands where present; cover - mean percent cover in stands where present; N - sample size)*

NAME	CONST/COVER
Litter	100/6
Rock	100/71
Soil	67/39
TREES	
Populus balsamifera	33/3
SHRUBS	
Alnus incana	33/3
Salix alaxensis	100/15
Vaccinium uliginosum	33/1
GRAMINOIDS	
Agropyron spp.	100/6
Agrostis spp.	33/1
Calamagrostis canadensis	67/3
Hierochloe alpina	33/1
Poa spp.	33/1

NAME	CONST/COVER
FORBS	
Allium schoenoprasum	33/1
Artemisia tilesii	100/6
Aster sibiricus	100/2
Astragalus alpinus	33/1
Epilobium angustifolium	33/3
Epilobium latifolium	67/3
Equisetum arvense	33/1
Galium boreale	67/1
Hedysarum alpinum	100/6
Lupinus arcticus	67/1
Mertensia paniculata	33/1
unknown forb	33/1
MOSSES	
moss (total)	67/1
Dicranum spp.	33/1
unknown moss	67/1
N	3

Gravelly colluvium

Structure: needleleaf or mixed, open forest or woodland /(tall scrub)/low scrub/moss

Major taxa: *Picea mariana, Betula papyrifera, Alnus crispa, Betula glandulosa, Spiraea beauverdiana, Vaccinium uliginosum, Hylocomium splendens, Pleurozium schreberi*

Setting: Mid- to lower slopes of bedrock-cored uplands

Map unit components: Cs3

Soils: Typic Cryochrepts, loamy-skeletal (Chapter 6)

Succession: Unknown due to small sample size (all sample sites have had more than 50 years since fire).

Comment: This site type is poorly defined due to the small sample size. Dense shrubs are probably due to inputs of nutrients in water moving downslope.

Vegetation and ground cover summary *(const - constancy, % of sample stands where present; cover - mean percent cover in stands where present; N - sample size)*

NAME	CONST/COVER
Litter	100/35
Soil	33/3
TREES	
Betula papyrifera	33/15
Picea glauca	33/15
Picea mariana	100/19
SHRUBS	
Alnus crispa	67/46
Betula glandulosa	100/23
Chamaedaphne calyculata	67/9
Empetrum nigrum	67/27
Ledum palustre	100/47
Ribes triste	33/3
Salix planifolia var. pulchra	33/3
Spiraea beauverdiana	100/39
Vaccinium uliginosum	100/63
Vaccinium vitis-idaea	100/23
GRAMINOIDS	
Carex bigelowii	33/15
unknown grass	33/3
FORBS	
Cornus canadensis	33/3
Equisetum sylvaticum	100/15
Linnaea borealis	33/15
Lycopodium alpinum	33/15
Lycopodium annotinum	67/21
Polygonum alaskanum	33/3
Rubus arcticus	33/15
Rubus chamaemorus	67/9

NAME	CONST/COVER
MOSSES	
moss (total)	100/71
Dicranum spp.	33/3
Hylocomium splendens	100/30
Pleurozium schreberi	100/26
Polytrichum spp.	67/9
Ptilium crista-castrensis	33/3
Sphagnum spp.	100/11
unknown moss	33/3
LICHENS	
lichen (total)	100/31
Bryoria spp.	100/11
Cetraria (dark color)	100/2
Cladina rangiferina	100/7
Cladina stellaris	100/7
Cladonia spp.	100/7
Nephroma arcticum	33/3
Peltigera spp.	33/3
Usnea spp.	67/8
arboreal crustose lichens	100/2
soil crustose lichens	33/3
N	3

Low mountain midslopes (forest)

Structure: needleleaf woodland or open mixed forest/tall scrub/low scrub/moss

Major taxa: *Picea mariana, Betula papyrifera, Alnus crispa, Spiraea beauverdiana, Vaccinium uliginosum, Hylocomium splendens*

Setting: Slopes of bedrock uplands

Map unit components: MI2

Soils: Typic Cryochrepts, loamy-skeletal (Chapter 6)

Succession: Poorly known due to small sample size and infrequency of fires. Low shrubs resprout vigorously after fires. Trees recover more gradually.

Comment: Rich vegetation (large trees, dense shrubs dominated by *Alnus crispa*, and rich forb flora) suggest a relatively fertile soil; probable nutrient sources are water moving downslope and mixing of mineral soil with organic matter by creep and treethrow. Mosses and lichens are suppressed by shading and litterfall.

Vegetation and ground cover summary *(const - constancy, % of sample stands where present; cover - mean percent cover in stands where present; 10-50, >100 - years since fire; ND - no data; dash indicates not present; N - sample size)*

NAME	CONST/COVER	
	10-50 yr	>100 yr
Litter	ND/38	100/61
Rock	ND/0	33/2
Soil	ND/3	100/2
Water	ND/0	-
TREES		
Betula papyrifera	ND/3	33/39
Picea glauca	-	67/27
Picea mariana	ND/15	50/15
SHRUBS		
Alnus crispa	ND/38	100/68
Andromeda polifolia	ND/3	-
Betula glandulosa	ND/15	50/27
Betula glandulosa X B. papyrifera	ND/15	-
Chamaedaphne calyculata	ND/15	33/9
Empetrum nigrum	ND/38	50/11
Juniperus communis	-	17/15
Ledum palustre	ND/63	50/7
Oxycoccus microcarpus	ND/3	-
Ribes triste	-	33/3
Rosa acicularis	-	33/15
Salix planifolia var. pulchra	ND/15	50/26
Spiraea beauverdiana	ND/15	83/39
Vaccinium uliginosum	ND/63	83/36
Vaccinium vitis-idaea	ND/63	83/13

NAME	CONST/COVER	
	10-50 yr	>100 yr
GRAMINOIDS		
Carex bigelowii	-	17/3
unknown grass	-	83/5
FORBS		
Cornus canadensis	-	33/32
Dryopteris dilatata	-	33/33
Epilobium angustifolium	ND/+	17/3
Equisetum sylvaticum	-	83/24
Geocaulon lividum	-	33/9
Gymnocarpium dryopteris	NS/+	-
Linnaea borealis	-	33/8
Lycopodium annotinum	ND/3	83/34
Lycopodium complanatum	-	17/3
Petasites hyperboreus	-	17/3
Polygonum alaskanum	ND/3	17/3
Rubus arcticus	-	17/3
Rubus chamaemorus	ND/+	67/3
Saxifraga punctata	-	17/1
Trientalis europaea	-	17/3
MOSSES		
moss (total)	ND/88	100/39
Dicranum spp.	-	83/5
Drepanocladus spp.	-	17/1
Hylocomium splendens	ND/38	83/15
Pleurozium schreberi	ND/15	50/23
Polytrichum spp.	ND/15	67/5
Ptilium crista-castrensis	-	17/3
Sphagnum spp.	ND/38	67/12
unknown moss	-	17/3
LICHENS		
lichen (total)	ND/15	100/19
Bryoria spp.	-	83/8
Cetraria (dark color)	-	17/1
Cladina mitis	ND/3	-
Cladina rangiferina	-	67/2
Cladina stellaris	-	33/2
Cladonia spp.	ND/15	100/3
Nephroma arcticum	-	17/1
Peltigera spp.	ND/+	33/2
Usnea spp.	-	67/9
arboreal crustose lichens	ND/3	100/4
soil crustose lichens	ND/3	-
N	1	6

Mudboil tundra

Structure: (needleleaf dwarf tree scrub woodland)/low scrub/graminoids/lichens

Major taxa: *Picea mariana, Ledum palustre, Vaccinium uliginosum, Eriophorum vaginatum, Cladina spp.*

Setting: Gentle slopes and crests of glacial moraines in the far western part of the study area

Map unit components: Ke1

Soils: Pergelic Cryaquepts, silty (Chapter 6)

Succession: Shrubs resprout quickly after fire and then decrease gradually after several decades. *Picea mariana* trees are never abundant, are stunted, and recover very slowly from fires. Lichens increase gradually over the first century or more, mainly due to an increase in *Cladina* lichens. *Cladonia* lichens peak several decades after fire and then decrease.

Comment: Conditions are drier here than on tussock tundra. Feathermoss cover is low in spite of mesic conditions, probably due to lack of trees (which supply nutrients through canopy drip). Trees are absent due to abrasion by windblown snow in combination with unfavorable soil conditions (i.e. near-surface permafrost).

Vegetation and ground cover summary *(const - constancy, % of sample stands where present; cover - mean percent cover in stands where present; 10-50, > 100 - years since fire; dash indicates not present; N - sample size)*

NAME	CONST/COVER	
	10-50 yr	>100 yr
Litter	100/23	100/6
Soil	100/3	100/1
Water	33/1	25/1
TREES		
Picea mariana	100/3	100/12
SHRUBS		
Arctostaphylos alpina	33/1	25/3
Betula glandulosa	100/15	100/12
Empetrum nigrum	100/23	100/9
Ledum palustre	100/55	100/33
Salix glauca	67/3	25/3
Salix planifolia var. pulchra	33/3	50/2
Spiraea beauverdiana	-	25/3
Vaccinium uliginosum	100/55	100/33
Vaccinium vitis-idaea	100/30	100/12
GRAMINOIDS		
Calamagrostis canadensis	33/1	-
Carex bigelowii	67/27	100/21
Carex spp.	33/38	-
Eriophorum angustifolium	33/3	-
Eriophorum vaginatum	100/11	75/11

NAME	CONST/COVER	
	10-50 yr	>100 yr
FORBS		
Equisetum sylvaticum	-	25/3
Geocaulon lividum	-	25/1
Pedicularis labradorica	100/1	25/1
Petasites frigidus	67/9	25/15
Petasites hyperboreus	33/3	-
Rubus chamaemorus	67/2	25/1
MOSSES		
moss (total)	100/23	100/12
Aulocomnium palustre	33/3	-
Aulocomnium turgidum	67/1	-
Dicranum spp.	100/15	100/2
Hylocomium splendens	-	25/15
Pleurozium schreberi	33/3	25/38
Polytrichum spp.	100/6	100/2
Sphagnum spp.	100/3	50/3
unknown moss	33/3	-
LICHENS		
Lichen (total)	100/38	100/88
Bryoria spp.	-	25/3
Cetraria (dark color)	67/8	100/3
Cetraria cucullata	100/2	100/12
Cetraria nivalis	-	25/3
Cladina mitis	67/15	100/9
Cladina rangiferina	67/9	100/21
Cladina stellaris	100/7	100/27
Cladonia spp.	100/11	75/3
Nephroma arcticum	100/11	75/14
Peltigera spp.	67/2	50/1
Stereocaulon spp.	-	25/1
arboreal crustose lichens	-	50/1
soil crustose lichens	67/2	25/1
N	3	4

Peat plateaus

Structure: needleleaf open forest or woodland/low scrub/mosses and lichens

Major taxa: *Picea mariana, Betula glandulosa, Ledum palustre, Vaccinium uliginosum, Sphagnum spp., Cladina spp.*

Setting: Level areas on moraines and terraces

Map unit components: Aw3, Tw4

Soils: Histosols (Chapter 6)

Succession: Vascular plants resprout or reseed quickly after fire, reaching former cover values in a few decades. A subsequent decrease in vascular plant cover after 50 years is possible. Lichens, dominantly *Cladina*, increase gradually after fire for a century or more. *Cladonia* spp. lichens peak a few decades after fire and decrease thereafter.

Comment: Peat plateaus are the most nutrient-poor and acidic sites in the study area. Hence the vegetation consists mainly nutrient-conserving plants: mosses, lichens, and evergreen vascular plants. *Rubus chamaemorus* is the only forb present. Soils are rather droughty (because runoff drains rapidly into associated thermokarst depressions), allowing lichens to compete with *Sphagnum* mosses. Feathermosses are nearly absent, probably because they require canopy-drip nutrients from trees. Thermokarst can convert areas of this site type to site type "Thermokarst depressions". Thermokarsting increases after fire.

Vegetation and ground cover summary *(const - constancy, % of sample stands where present; cover - mean percent cover in stands where present; 10-50, >50 - years since fire; dash indicates not present; N - sample size)*

NAME	CONST/COVER	
	10-50 yr	>50 yr
Litter	100/19	100/11
Soil	100/2	100/2
Water	67/2	-
TREES		
Picea mariana	100/30	100/15
SHRUBS		
Andromeda polifolia	33/3	-
Betula glandulosa	100/23	100/31
Chamaedaphne calyculata	100/15	67/9
Empetrum nigrum	67/3	-
Ledum palustre	100/46	100/46
Oxycoccus microcarpus	33/1	100/2
Potentilla fruticosa	-	33/3
Spiraea beauverdiana	33/3	33/15
Vaccinium uliginosum	100/38	100/23
Vaccinium vitis-idaea	100/11	100/10

NAME	CONST/COVER	
	10-50 yr	>50 yr
GRAMINOIDS		
Calamagrostis canadensis	-	33/1
Carex bigelowii	33/1	-
Carex spp.	-	33/1
Eriophorum vaginatum	67/3	33/3
unknown sedge	-	33/1
FORBS		
Rubus chamaemorus	100/23	100/23
MOSSES		
moss (total)	100/55	100/47
Aulocomnium palustre	33/1	33/15
Dicranum spp.	67/1	67/3
Pleurozium schreberi	-	100/7
Polytrichum spp.	100/6	67/2
Sphagnum spp.	100/47	100/30
unknown moss	-	33/1
LICHENS		
lichen (total)	100/23	100/55
Bryoria spp.	33/1	67/3
Cetraria (dark color)	100/2	67/2
Cetraria cucullata	67/1	33/1
Cetraria islandica	-	33/1
Cladina mitis	100/2	33/15
Cladina rangiferina	100/2	100/19
Cladina stellaris	100/2	100/27
Cladonia spp.	100/15	67/9
Nephroma arcticum	33/1	33/1
Peltigera spp.	33/1	-
arboreal crustose lichens	-	33/1
soil crustose lichens	100/2	67/2
N	3	3

Pit and mound depressions, tundra

Structure: low scrub/graminoids/mosses and lichens

Major taxa: *Ledum palustre, Vaccinium spp., Eriophorum spp., Sphagnum spp., Cladina spp.*

Setting: On mounds between thermokarst pits in broad depressions and flat areas on glacial moraines; in the far western part of the study area

Map unit components: Ae5, Ke4

Soils: Cryaquepts; Histosols (Chapter 6)

Succession: Unknown due to the small sample size and poor indicators of time since the last fire.

Comment: A poorly defined type due to its rarity in the study area. Generally dominated by nutrient-conserving plants rooting in the thick, acid organic surface soil. These sites are moist thanks to near-surface permafrost, but free water can generally drain into adjacent thermokarst depressions, allowing a rather dense shrub and lichen cover to develop.

Vegetation and ground cover summary *(const - constancy, % of sample stands where present; cover - mean percent cover in stands where present; N - sample size)*

NAME	CONST/COVER
Litter	100/51
Soil	100/3
Water	50/3
TREES	
Picea mariana	100/3
SHRUBS	
Andromeda polifolia	50/15
Betula glandulosa	100/15
Chamaedaphne calyculata	50/3
Empetrum nigrum	50/15
Ledum palustre	100/27
Oxycoccus microcarpus	50/1
Salix planifolia var. pulchra	50/3
Spiraea beauverdiana	50/3
Vaccinium uliginosum	100/27
Vaccinium vitis-idaea	100/27
GRAMINOIDS	
Carex spp.	100/3
Eriophorum russeolum	50/38
Eriophorum vaginatum	100/39
FORBS	
Pedicularis labradorica	50/3
Rubus chamaemorus	100/15

	CONST/COVER
MOSSES	
moss (total)	100/52
Dicranum spp.	50/3
Polytrichum spp.	50/1
Sphagnum spp.	100/46
unknown moss	50/3
LICHENS	
lichen (total)	100/39
Cetraria (dark color)	100/9
Cetraria cucullata	100/9
Cetraria nivalis	50/3
Cladina rangiferina	100/9
Cladina stellaris	100/9
Cladonia spp.	100/9
soil crustose lichens	100/2
N	2

Rarely flooded river flood plain with permafrost

Structure: needleleaf open forest or woodland, or dwarf tree scrub/(open tall scrub)/closed low scrub/moss

Major taxa: *Picea mariana, Ledum palustre, Vaccinium uliginosum, Hylocomium splendens*

Setting: Flood plains of the Kobuk and Reed Rivers; on higher surfaces than other flood plain sites

Map unit components: Fr1

Soils: Pergelic Cryaquepts (Chapter 6)

Succession: In the absence of fire the vegetation is usually stable; however, plants that have persisted from preceding, more frequently flooded times (*Picea glauca, Alnus crispa, Salix, spp.*, and all forbs except *Rubus chamaemorus*) may gradually die out. After fires, shrubs resprout and *Picea mariana* trees reseed and reach former cover levels within a few decades after fire. Fires may help *Picea mariana* replace *Picea glauca* as the latter species is less well adapted to reseed after fire. *Polytrichum spp.* tends to increase after fire while lichens and *Hylocomium splendens* recover slowly.

Comment: Restriction of rooting to acidic organic surface layers results in a plant assemblage dominated by nutrient-conserving, evergreen plants. However, inputs of mineral material with rare floods, and seed rain from the nearby active flood plain may help maintain some deciduous shrubs and forbs (e.g. *Rosa acicularis, Linnaea borealis*) at low densities on some sites. A combination of processes facilitate formation of this type from "Dry, occasionally flooded river floodplain (white spruce/alder forest)" over the long term: accumulation of silt and fine sand (with consequent increase in soil water-holding capacity, raising of the surface, and, as a result of the latter, decrease in flooding frequency), accumulation of a surface soil organic mat, and plant succession.

Vegetation and ground cover summary *(const - constancy, % of sample stands where present; cover - mean percent cover in stands where present; 10-50, >100 - years since fire; dash indicates not present; N - sample size)*

NAME	CONST/COVER	
	10-50 yr	>100 yr
Litter	100/52	100/23
Soil	100/3	100/2
Water	-	57/2
TREES		
Betula papryifera	-	43/7
Picea glauca	-	57/15
Picea mariana	100/27	86/31
SHRUBS		
Alnus crispa	-	57/15
Alnus incana	-	14/3
Andromeda polifolia	-	14/3
Arctostaphylos rubra	-	43/3
Arctostaphylos spp.	-	14/15
Betula glandulosa	100/27	86/23

NAME	CONST/COVER	
	10-50 yr	>100 yr
SHRUBS (cont)		
Betula glandulosa X B. papyrifera	-	29/9
Chamaedaphne calyculata	-	57/12
Dryas spp.	-	14/3
Empetrum nigrum	50/3	86/15
Ledum palustre	100/52	100/64
Oxycoccus microcarpus	-	43/1
Potentilla fruticosa	-	29/2
Rosa acicularis	-	43/3
Salix alaxensis	-	14/3
Salix glauca	-	43/11
Salix lanata ssp. richardsonii	-	29/15
Salix planifolia var. pulchra	100/15	57/12
Salix reticulata	-	14/3
Spiraea beauverdiana	50/15	43/11
Vaccinium uliginosum	100/63	100/59
Vaccinium vitis-idaea	100/15	86/19
GRAMINOIDS		
Arctagrostis latifolia	50/15	14/5
Arctagrostis spp.	-	14/3
Calamagrostis canadensis	-	14/3
Carex bigelowii	-	29/9
Carex spp.	100/9	57/9
Eriophorum russeolum	-	14/3
Eriophorum vaginatum	50/88	43/7
unknown grass	50/1	14/1
FORBS		
Equisetum arvense	-	29/9
Equisetum pratense	50/1	43/6
Equisetum sylvaticum	50/1	29/3
Geocaulon lividum	-	14/3
Iris setosa	-	29/1
Linnaea borealis	-	29/1
Lupinus arcticus	-	14/1
Lycopodium annotinum	-	29/2
Mertensia paniculata	-	14/1
Moneses uniflora	-	14/1
Parnassia palustris	-	14/1
Pedicularis labradorica	-	14/3
Petasites frigidus	-	14/1
Petasites hyperboreus	50/3	-
Rubus arcticus	-	57/3
Rubus chamaemorus	50/15	71/51

NAME	CONST/COVER	
	10-50 yr	>100 yr
FORBS (cont)		
Saussurea angustifolia	-	14/15
Solidago multiradiata	-	14/1
Tofieldia pusilla	-	14/1
unknown forb	-	14/1
MOSSES		
moss (total)	100/76	100/77
Aulocomnium palustre	50/15	57/12
Dicranum spp.	50/15	86/11
Hylocomium splendens	100/15	100/35
Pleurozium schreberi	100/27	71/10
Polytrichum spp.	100/27	71/5
Rhytidiadelphus triquestrus	-	14/3
Sphagnum spp.	100/20	71/29
Tomenthypnum nitens	-	43/10
unknown moss	-	57/3
LICHENS		
lichen (total)	100/15	100/32
Bryoria spp.	50/3	100/1
Cetraria (dark color)	-	71/4
Cetraria islandica	-	14/3
Cladina mitis	-	43/6
Cladina rangiferina	50/3	86/7
Cladina stellaris	100/3	71/10
Cladonia spp.	100/9	100/6
Nephroma arcticum	100/2	43/2
Peltigera spp.	100/3	100/2
Usnea spp.	-	86/1
arboreal crustose lichens	50/1	86/2
soil crustose lichens	50/1	14/1
N	2	7

Ribbed fens

Structure: open low scrub/graminoids in flark; closed low scrub/graminoids/moss on string
Major taxa: *Myrica gale, Cyperaceae, Sphagnum spp.*
Setting: Terraces in zones of groundwater discharge
Map unit components: Tw2
Soils: Histosols, ponded (Chapter 6)
Succession: Unknown due to small sample size and lack of indicators of time since fire. Sparse vegetation may not carry fires very well. Wetness probably preserves basal plant parts, allowing rapid resprouting after fires.
Comment: Flora specialized to very wet, moderately nutrient-rich conditions. *Trichophorum alpinum, Triglochin maritimum,* an unknown sedge, *Drosera anglica,* and *Platanthera hyperborea* were recorded here and nowhere else in the study area. Strings are low ridges perpendicular to the water flow direction; they have more *Sphagnum* moss and shrubs than the flarks (hollows between strings).

Vegetation and ground cover summary *(flark - sample in wet hollow; string - sample on ridge; + indicates 0-1% cover; dash indicates not present; N - sample size)*

NAME	COVER, %	
	FLARK	STRING
Litter	88	63
Soil	15	15
Water	+	15
SHRUBS		
Andromeda polifolia	+	-
Betula glandulosa	3	3
Juniperus communis	-	+
Myrica gale	15	38
Potentilla fruticosa	3	15
GRAMINOIDS		
Calamagrostis canadensis	-	3
Carex limosa	-	15
Carex aquatilis	15	15
Carex spp.	+	-
Eriophorum angustifolium	-	3
Eriophorum spp.	-	3
Trichophorum alpinum	+	-
Triglochin maritimum	+	-
unknown sedge	88	63

NAME	COVER, %	
	FLARK	STRING
FORBS		
Drosera anglica	3	15
Drosera rotundifolia	+	+
Iris setosa	-	+
Menyanthes trifoliata	3	3
Platanthera hyperborea	-	+
Tofieldia pusilla	-	+
Trientalis europaea	-	3
unknown forb	+	-
MOSSES		
moss (total)	3	63
Sphagnum spp.	3	63
unknown moss	+	-
N	1	1

Small stream flood plains in bedrock uplands

Structure: needleleaf woodland/closed tall scrub/low scrub
Major taxa: *Picea glauca, Alnus crispa, Salix spp., Vaccinium uliginosum*
Setting: Drainages in small valleys and on slopes of bedrock uplands
Map unit components: Ca5, Ck4, Cs2
Soils: variable, mainly Cryofluvents, hillslopes (Chapter 6)
Succession: Vegetation is apparently stable under the existing flooding regime. Post-fire succession is unknown due to the rarity of burns.
Comment: Dense *Alnus crispa* and *Salix spp.* shrubs, and rich forb flora are due to inputs of nutrients with floodwaters. Mosses and lichens are suppressed by flood deposition and litterfall. The lush deciduous vegetation resists fires. If flooding becomes less frequent (due to channel migration), these sites should convert to "Striped colluvial slopes" (in places where the surface soil is loamy) or "Gravelly colluvium" (in places where the surface soil is coarse-grained).

Vegetation and ground cover summary *(const - constancy, % of sample stands where present; cover - mean percent cover in stands where present; N - sample size)*

NAME	CONST/COVER
Litter	100/63
Rock	20/2
Soil	100/8
Water	30/11
TREES	
Betula papyrifera	40/12
Picea glauca	70/15
Picea mariana	60/11
SHRUBS	
Alnus crispa	90/51
Arctostaphylos rubra	10/3
Betula glandulosa	60/11
Chamaedaphne calyculata	30/11
Empetrum nigrum	10/3
Ledum palustre	30/14
Oxycoccus microcarpus	10/15
Potentilla fruticosa	20/9
Ribes triste	50/1
Rosa acicularis	10/15

NAME	CONST/COVER
SHRUBS (cont)	
Salix alaxensis	10/15
Salix arctica	10/1
Salix glauca	10/38
Salix lanata ssp. richardsonii	60/45
Salix planifolia X S. lanata	10/3
Salix planifolia var. pulchra	90/35
Shepherdia canadensis	10/3
Spiraea beauverdiana	60/13
Vaccinium uliginosum	80/34
Vaccinium vitis-idaea	60/7
GRAMINOIDS	
Agrostis spp.	10/15
Calamagrostis canadensis	20/9
Carex spp.	10/15
Eriophorum vaginatum	10/3
unknown grass	40/9
FORBS	
Aconitum delphinifolium	20/1
Artemisia tilesii	10/3
Cornus canadensis	10/38
Equisetum arvense	30/10
Equisetum pratense	30/15
Equisetum sylvaticum	60/15
Geocaulon lividum	30/6
Linnaea borealis	30/3
Lycopodium annotinum	40/33
Lycopodium clavatum	10/38
Lycopodium selago	20/2
Mertensia paniculata	10/1
Petasites frigidus	20/9
Polygonum alaskanum	10/1
Potentilla palustris	30/7
Pyrola secunda	10/1
Ranunculus lapponicus	50/3
Rubus arcticus	60/7
Rubus chamaemorus	40/11
Saxifraga punctata	30/2
Valeriana capitata	10/1
Viola epipsila	20/2
Wilhelmsia physodes	10/3
unknown forb	10/1

NAME	CONST/COVER
MOSSES	
moss (total)	100/34
liverwort	30/2
Aulocomnium palustre	20/3
Bryum spp.	10/3
Dicranum spp.	40/3
Drepanocladus spp.	40/6
Hylocomium splendens	40/27
Mniumm spp.	20/21
Pleurozium schreberi	20/9
Polytrichum spp.	30/2
Rhizomnium spp.	20/8
Sphagnum spp.	70/14
Tomenthypnum nitens	10/1
unknown moss	100/7
LICHENS	
lichen (total)	100/6
Bryoria spp.	40/2
Cetraria (dark color)	10/3
Cladina rangiferina	30/2
Cladina stellaris	10/3
Cladonia spp.	70/4
Nephroma arcticum	10/1
Peltigera spp.	10/1
Usnea spp.	20/1
arboreal crustose lichens	90/2
soil crustose lichens	20/1
N	10

Small stream flood plains on moraines

Structure: closed tall scrub/low scrub/moss

Major taxa: *Salix spp., Vaccinium uliginosum, Calamagrostis canadensis, Drepanocladus spp., Sphagnum spp.*

Setting: Drainages in small valleys on moraines

Map unit components: Ae4, Ah4, Aw5, Ke5, Ko6

Soils: various

Succession: Vegetation is probably stable under the existing flooding regime. Post-fire succession is unknown due to rarity of wildfires.

Comment: Dense shrubs (especially *Salix spp.*) due to the input of nutrients with flooding. Mosses and lichens are suppressed by flood deposition and litterfall, though not as completely as in the analogous sites on bedrock uplands. Lush deciduous vegetation resists fires.

Vegetation and ground cover summary *(const - constancy, % of sample stands where present; cover - mean percent cover in stands where present; N - sample size)*

NAME	CONST/COVER
Litter	100/57
Rock	25/1
Soil	100/18
Water	50/8
TREES	
Picea glauca	25/3
SHRUBS	
Betula glandulosa	25/3
Chamaedaphne calyculata	50/3
Myrica gale	25/38
Potentilla fruticosa	25/15
Salix alaxensis	25/15
Salix fuscescens	25/15
Salix lanata ssp. richardsonii	50/27
Salix planifolia var. pulchra	100/51
Vaccinium uliginosum	100/57
GRAMINOIDS	
Agrostis spp.	25/15
Calamagrostis canadensis	75/23
Carex aquatilis	25/3
Carex spp.	25/1
Eriophorum vaginatum	25/3

NAME	CONST/COVER
FORBS	
Equisetum arvense	25/15
Equisetum variegatum	25/1
Parnassia palustris	50/1
Potentilla palustris	100/9
Ranunculus lapponicus	75/6
Rubus arcticus	25/15
Viola epipsila	50/2
MOSSES	
moss (total)	100/45
liverwort	25/1
Campylium spp.	50/2
Dicranum spp.	25/3
Drepanocladus spp.	100/21
Mniumm spp.	25/15
Polytrichum spp.	25/3
Rhizomnium spp.	25/3
Sphagnum spp.	75/30
Tomenthypnum nitens	25/3
unknown moss	100/6
LICHENS	
lichen (total)	50/8
Cetraria (dark color)	25/15
Cladonia spp.	25/1
arboreal crustose lichens	25/1
N	4

Steep forested high mountain slopes

Structure: mixed forest/low scrub/moss

Major taxa: *Betula papyrifera, Picea mariana, Vaccinium vitis-idaea, Hylocomium splendens*

Setting: Rubbly slopes of high mountains protected by topography from avalanches; below treeline

Map unit components: Mh1

Soils: Orthents (Chapter 6)

Succession: Unknown due to the small sample size and rarity of fires.

Comment: These sites are rather variable as a function of slope aspect. The south-facing example (i.e. warm and dry) has large trees and little understory or moss due to shading and litterfall. The west-facing slopes have a more open canopy with mosses and dense shrubs. Slope instability (downslope movement by creep) has a major effect on the vegetation: it allows the growth of various nutrient-demanding forbs by mixing fresh mineral material into the surface soil; and it seems to favor trees that can reproduce by layering (*Betula papyrifera* and *Picea mariana)* as lower branches are buried by creep material.

Vegetation and ground cover summary *(S - sample stand with south slope aspect; W1, W2 - sample stands with west slope aspect; + indicates 0-1% cover; dash indicates not present; N - sample size)*

NAME	COVER, %		
	S	W1	W2
Litter	88	38	15
Rock	+	15	15
Soil	3	+	3
Water	0	0	0
TREES			
Betula papyrifera	38	15	15
Picea glauca	15	-	-
Picea mariana	15	38	15
SHRUBS			
Alnus crispa	-	15	15
Betula glandulosa	-	3	38
Betula glandulosa X B. papyrifera	-	-	3
Empetrum nigrum	-	15	-
Ledum palustre	-	15	63
Spiraea beauverdiana	15	15	-
Vaccinium uliginosum	3	38	15
Vaccinium vitis-idaea	15	63	38
GRAMINOIDS			
Calamagrostis canadensis	+	+	-
Hierochloe alpina	-	+	+

NAME	COVER, %		
	S	W1	W2
FORBS			
Arnica frigida	-	+	-
Dryopteris fragrans	-	+	-
Geocaulon lividum	-	+	-
Linnaea borealis	+	+	-
Lycopodium annotinum	3	+	-
Lycopodium complanatum	-	+	-
Rubus chamaemorus	-	+	-
Saxifraga bronchialis ssp. funstonii	-	+	-
Selaginella sibirica	-	+	-
Solidago multiradiata	-	+	-
unknown forb	-		-
MOSSES			
moss (total)	3	63	63
liverwort	-	-	+
Dicranum spp.	3	3	3
Drepanocladus spp.	3	-	3
Hylocomium splendens	+	38	38
Pleurozium schreberi	-	3	-
Polytrichum spp.	+	+	3
Ptilium crista-castrensis	-	-	3
Racomitrium lanuginosum	-	-	+
Rhytidium rugosum	-	+	-
unknown moss	-	3	+
LICHENS			
lichen (total)	3	38	38
Cetraria (dark color)	-	-	+
Cetraria cucullata	-	-	3
Cetraria nivalis	-	-	+
Cladina mitis	-	3	-
Cladina rangiferina	-	3	15
Cladina stellaris	-	3	15
Cladonia spp.	+	3	3
Peltigera spp.	-	-	+
Stereocaulon spp.	-	-	+
Thamnolia spp.	-	-	+
arboreal crustose lichens	+	+	+
soil crustose lichens	+	15	15
unknown lichen	-	-	3
N	1	1	1

Steep north mountain slopes with permafrost

Structure: (needleleaf open forest or woodland)/tall scrub/low scrub/moss

Major taxa: *Picea mariana, Alnus crispa, Betula glandulosa, Ledum palustre, Vaccinium uliginosum, Hylocomium splendens, Sphagnum spp.*

Setting: Steep north-facing slopes of bedrock uplands

Map unit components: MI4

Soils: see Chapter 3, map unit MI, component 4

Succession: Unknown due to small sample size.

Comment: High permafrost table and thick, acid organic layer combine to produce an acid, infertile rooting zone; hence the dominant plants are acid-tolerant ericaceous shrubs, *Betula glandulosa*, and mosses. However, movement of material down these very steep slopes introduces enough nutrients to allow the growth of a few more nutrient-demanding plants, such as *Alnus crispa, Salix spp., Polygonum alaskanum,* and *Geocaulon lividum.* The latter species also suggest droughtiness due to rapid runoff.

Vegetation and ground cover summary *(const - constancy, % of sample stands where present; cover - mean percent cover in stands where present; N - sample size)*

NAME	CONST/COVER
Litter	100/6
Rock	25/3
Soil	50/1
TREES	
Picea glauca	25/3
Picea mariana	75/11
SHRUBS	
Alnus crispa	100/21
Andromeda polifolia	50/3
Arctostaphylos alpina	50/9
Arctostaphylos rubra	50/9
Betula glandulosa	100/33
Cassiope tetragona	25/3
Chamaedaphne calyculata	25/15
Empetrum nigrum	100/24
Ledum palustre	100/51
Oxycoccus microcarpus	50/3
Salix glauca	25/15
Salix lanata ssp. richardsonii	25/15
Salix planifolia var. pulchra	50/9
Spiraea beauverdiana	75/2
Vaccinium uliginosum	100/45
Vaccinium vitis-idaea	100/21

NAME	CONST/COVER
GRAMINOIDS	
Calamagrostis canadensis	50/3
Carex bigelowii	25/3
Carex spp.	50/2
Eriophorum vaginatum	25/3
Hierochloe alpina	25/1
unknown grass	25/15
FORBS	
Equisetum pratense	25/3
Geocaulon lividum	50/2
Lycopodium annotinum	50/8
Lycopodium clavatum	25/3
Polygonum alaskanum	25/3
Rubus chamaemorus	50/3
MOSSES	
moss (total)	100/54
Aulocomnium turgidum	75/2
Dicranum spp.	25/1
Hylocomium splendens	100/21
Pleurozium schreberi	75/7
Polytrichum spp.	75/2
Racomitrium lanuginosum	25/1
Rhytidium rugosum	25/3
Sphagnum spp.	75/39
LICHENS	
lichen (total)	100/30
Bryoria spp.	25/3
Cetraria (dark color)	100/5
Cetraria cucullata	50/9
Cetraria nivalis	25/3
Cladina mitis	100/3
Cladina rangiferina	100/12
Cladina stellaris	100/6
Cladonia spp.	75/6
Peltigera spp.	50/1
Thamnolia spp.	25/1
arboreal crustose lichens	50/1
soil crustose lichens	25/1
N	4

Striped colluvial slopes

Structure: needleleaf open forest or woodland/(tall scrub)/low scrub/graminoids/moss

Major taxa: *Picea mariana, Alnus crispa, Ledum palustre, Vaccinium uliginosum, Carex spp., Sphagnum spp.*

Setting: Long slopes of bedrock uplands and moraines

Map unit components: Ca1, Ck1, Cs1, Ko2

Soils: Cryaquepts, loamy substratum; Cryaquepts (Chapter 6)

Succession: Trends are weak, probably due to the generally light fires on this site. Vascular plants resprout or reseed to former cover values within several decades after fire.

Comment: The stripe pattern is due to slightly more abundant shrubs along faint drainage lines. Shrubs are probably responding to nutrients introduced by runoff water. Conversion of parts of this site type to "Small stream flood plains on bedrock uplands" and vice versa is possible as streams migrate across the slope.

Vegetation and ground cover summary *(const - constancy, % of sample stands where present; cover - mean percent cover in stands where present; < 10, 10-> 100 - years since fire; ND - no data; dash indicates not present; N - sample size)*

NAME	CONST/COVER	
	< 10 yr	10 - > 100 yr
Litter	ND/38	100/21
Rock	ND/0	16/1
Soil	ND/38	95/5
Water	ND/0	37/2
TREES		
Picea mariana	ND/+	100/28
SHRUBS		
Alnus crispa	-	63/13
Andromeda polifolia	-	11/3
Arctostaphylos rubra	-	16/11
Betula glandulosa	ND/3	100/24
Chamaedaphne calyculata	-	21/12
Empetrum nigrum	ND/3	89/13
Ledum palustre	ND/15	100/42
Oxycoccus microcarpus	ND/+	74/3
Rosa acicularis	-	11/3
Salix glauca	-	5/15
Salix lanata ssp. richardsonii	-	16/11
Salix planifolia var. pulchra	-	68/11
Spiraea beauverdiana	ND/+	26/5
Vaccinium uliginosum	ND/15	100/59
Vaccinium vitis-idaea	ND/3	100/24

NAME	CONST/COVER	
	<10 yr	10 - >100 yr
GRAMINOIDS		
Arctagrostis latifolia	-	11/3
Calamagrostis canadensis	-	5/1
Carex bigelowii	ND/15	47/24
Carex spp.	-	32/21
Eriophorum vaginatum	-	37/16
unknown grass	-	11/3
FORBS		
Equisetum arvense	-	5/3
Equisetum sylvaticum	-	63/12
Geocaulon lividum	-	16/7
Lycopodium annotinum	-	26/5
Pedicularis labradorica	-	5/1
Petasites frigidus	-	11/2
Petasites hyperboreus	-	16/3
Polygonum alaskanum	-	5/1
Pyrola secunda	-	11/1
Ranunculus lapponicus	-	16/2
Rubus chamaemorus	ND/15	89/25
unknown forb	-	5/1
MOSSES		
moss (total)	ND/15	100/71
liverwort	-	16/1
Aulocomnium palustre	-	32/8
Aulocomnium turgidum	-	5/1
Dicranum spp.	-	53/3
Hylocomium splendens	-	74/28
Mniumm spp.	-	5/1
Pleurozium schreberi	ND/+	84/19
Polytrichum spp.	ND/3	58/5
Sphagnum spp.	ND/15	100/36
Sphagnum warnstorfii	-	5/3
Tomenthypnum nitens	-	11/2
unknown moss	-	26/8

NAME	CONST/COVER	
	<10 yr	10 - >100 yr
LICHENS		
lichen (total)	ND/3	100/38
Bryoria spp.	-	84/10
Cetraria (dark color)	-	74/3
Cetraria cucullata	-	32/3
Cladina mitis	-	32/8
Cladina rangiferina	-	95/16
Cladina stellaris	-	100/16
Cladonia spp.	ND/+	100/7
Nephroma arcticum	ND/+	84/3
Peltigera spp.	-	47/2
Stereocaulon spp.	-	5/1
Usnea spp.	-	21/2
arboreal crustose lichens	-	84/2
soil crustose lichens	-	21/1
unknown lichen	ND/3	5/1
N	1	19

Thermokarst depressions

Structure: (open low scrub)/graminoids/moss
Major taxa: *Chamaedaphne calyculata, Carex spp., Sphagnum spp.*
Setting: Wet depressions from thermokarst subsidence on moraines and terraces
Map unit components: Aw4, Kw4, Tw2
Soils: Histosols, ponded (Chapter 6)
Succession: Vegetation is probably stable if wetness conditions remain unchanged. Post-fire succession is unknown due to the low flammability of the vegetation on this site. Over the long term, peat accumulation could raise the surface enough to allow more shrubs to become established. However, changes in wetness conditions due to drainage of a depression (when erosion by a nearby stream breaches a depression and lowers the water table) are more likely to affect the vegetation.
Comment: Forms by thermokarst from site types "Frozen moraines and terraces, forested", "Peat plateau", "Pit and mound depressions, tundra", "Tussock wetland", and "Wet, nearly level areas with peat on moraines". Wet conditions and low mineral nutrient content of the water (because water is derived locally by runoff through acidic organic surface soil horizons) produce a *Sphagnum*- and sedge-dominated plant assemblage with scattered low shrubs. Wetland forbs such as *Menyanthes trifoliata* and *Potentilla palustris* are locally abundant. The water table is apparently always near the surface, probably because the peat soil and dense near-surface root mat float in response to fluctuations in the water level. If the depression is drained by breaching, the surface will frost heave upward, further reducing groundwater influence and producing the sites listed above.

Vegetation and ground cover summary *(const - constancy, % of sample stands where present; cover - mean percent cover in stands where present; N - sample size)*

NAME	CONST/COVER
Litter	90/41
Soil	60/6
Water	100/17
TREES	
Picea mariana	50/2
SHRUBS	
Andromeda polifolia	40/30
Betula glandulosa	30/11
Chamaedaphne calyculata	90/17
Empetrum nigrum	10/3
Ledum palustre	50/5
Oxycoccus microcarpus	50/17
Salix fuscescens	20/2
Salix planifolia var. pulchra	10/1
Spiraea beauverdiana	10/1
Vaccinium uliginosum	50/9

NAME	CONST/COVER
GRAMINOIDS	
Calamagrostis canadensis	10/1
Carex limosa	30/27
Carex aquatilis	60/51
Carex magellanica	10/3
Carex spp.	30/43
Eleocharis quinqueflora	10/15
Eriophorum russeolum	20/9
Eriophorum spp.	80/25
Eriophorum vaginatum	10/3
FORBS	
Drosera rotundifolia	20/3
Menyanthes trifoliata	20/51
Polemonium acutiflorum	10/1
Potentilla palustris	30/19
Rubus chamaemorus	10/3
MOSSES	
moss (total)	100/83
Aulocomnium palustre	30/7
Polytrichum spp.	50/3
Sphagnum spp.	90/88
unknown moss	50/12
LICHENS	
lichen (total)	30/6
Cetraria (dark color)	20/1
Cladina stellaris	20/2
Cladonia spp.	10/3
soil crustose lichens	10/1
N	10

Tussock tundra

Structure: low scrub/graminoids/moss

Major taxa: *Ledum palustre, Vaccinium spp., Eriophorum vaginatum, Sphagnum spp.*

Setting: Gentle slopes and broad crests of glacial moraines in the far western part of the study area

Map unit components: Ae1, Ke3

Soils: Cryaquepts (Chapter 6)

Succession: Unknown due to lack of indicators of time since fire. Shrubs and sedges probably resprout quickly after fire, such that the vegetation probably resembles the pre-fire state within a decade after fire.

Comment: Wet conditions favor dominance of *Eriophorum vaginatum* and *Sphagnum spp.* Trees are nearly absent due to wetness and abrasion by windblown snow.

Vegetation and ground cover summary *(const - constancy, % of sample stands where present; cover - mean percent cover in stands where present; N - sample size)*

NAME	CONST/COVER
Litter	100/24
Soil	100/1
Water	60/1
TREES	
Picea mariana	80/2
SHRUBS	
Andromeda polifolia	20/1
Betula glandulosa	100/15
Empetrum nigrum	40/9
Ledum palustre	100/38
Oxycoccus microcarpus	40/1
Vaccinium uliginosum	100/24
Vaccinium vitis-idaea	100/24
GRAMINOIDS	
Carex bigelowii	100/15
Eriophorum vaginatum	100/68
Rubus chamaemorus	100/8
MOSSES	
moss (total)	100/29
Aulocomnium turgidum	20/1
Dicranum spp.	100/1
Pleurozium schreberi	40/1
Polytrichum spp.	100/1
Sphagnum spp.	100/29

NAME	CONST/COVER
LICHENS	
lichen (total)	100/22
Cetraria (dark color)	60/2
Cetraria cucullata	100/7
Cladina mitis	60/7
Cladina rangiferina	100/7
Cladina stellaris	100/2
Cladonia spp.	60/2
Nephroma arcticum	60/2
Peltigera spp.	60/1
soil crustose lichens	40/1
N	5

Tussock wetland

Structure: dwarf tree scrub woodland/closed low scrub/graminoids/moss

Major taxa: *Picea mariana, Betula glandulosa, Ledum palustre, Vaccinium uliginosum, Eriophorum vaginatum, Sphagnum spp.*

Setting: Terraces and gentle moraine slope; occurs in the forested (as opposed to tundra) portion of the study area

Map unit components: Aw1, Kw1, Tw1

Soils: Cryaquepts; Cryaquepts, gravelly substratum (Chapter 6)

Succession: *Eriophorum* flourishes immediately after fire, and then appears to decrease, probably due to competition from other plants. Shrubs recover gradually during the first century after fire and then apparently decrease thereafter. *Picea mariana* also increases gradually over the first century. Lichens (mainly *Cladina spp.*) increase gradually over the first century or more.

Comment: Vascular flora is rather poor due to wetness combined with moderately nutrient-poor conditions. Woody plants recover more slowly after fire here than on drier sites. Thermokarst can convert small areas of this site type to site type "Thermokarst depressions".

Vegetation and ground cover summary *(const - constancy, % of sample stands where present; cover - mean percent cover in stands where present; < 10, 10-50, 50-100, > 100 - years since fire; dash indicates not present; N - sample size)*

NAME	CONST/COVER			
	< 10 yr	10-50 yr	50-100 yr	> 100 yr
Litter	100/9	100/20	100/15	100/21
Soil	100/27	100/2	100/2	100/1
Water	50/3	20/1	33/1	50/2
TREES				
Picea mariana	100/3	100/10	100/15	100/15
SHRUBS				
Andromeda polifolia	50/3	-	33/15	50/2
Betula glandulosa	100/9	100/20	100/15	100/18
Chamaedaphne calyculata	50/3	40/15	33/15	50/3
Empetrum nigrum	-	60/3	67/9	50/3
Ledum palustre	100/15	100/43	100/63	100/45
Oxycoccus microcarpus	100/8	80/2	100/2	100/1
Salix planifolia var. pulchra	-	-	33/15	-
Vaccinium uliginosum	100/9	100/39	100/63	100/42
Vaccinium vitis-idaea	100/9	100/20	100/23	100/12
GRAMINOIDS				
Carex bigelowii	50/15	80/15	67/21	25/3
Eriophorum vaginatum	100/63	100/73	67/38	100/39
unknown grass	-	-	-	25/1

NAME	CONST/COVER			
	< 10 yr	10-50 yr	50-100 yr	> 100 yr
FORBS				
Pedicularis labradorica	-	20/1	33/1	-
Rubus chamaemorus	100/27	100/17	100/23	100/21
MOSSES				
moss (total)	100/63	100/53	100/88	100/45
Aulocomnium palustre	-	60/6	-	-
Dicranum spp.	-	80/2	100/6	50/9
Hylocomium splendens	-	-	33/3	-
Pleurozium schreberi	-	20/15	100/19	50/3
Polytrichum spp.	100/2	100/7	67/3	100/3
Sphagnum spp.	100/63	100/34	100/71	100/39
Tomenthypnum nitens	-	20/3	-	-
unknown moss	-	40/3	-	-
LICHENS				
lichen (total)	100/15	100/20	100/38	100/51
Bryoria spp.	-	20/3	100/7	25/3
Cetraria (dark color)	-	60/2	67/2	100/2
Cetraria cucullata	50/1	40/2	100/6	75/2
Cladina mitis	-	40/2	-	-
Cladina rangiferina	50/3	80/6	100/15	100/18
Cladina stellaris	50/1	80/6	100/15	100/21
Cladonia spp.	100/3	100/5	100/7	100/6
Nephroma arcticum	50/3	80/2	67/2	25/3
Peltigera spp.	100/1	60/2	33/3	25/3
Stereocaulon spp.	-	20/1	-	-
arboreal crustose lichens	-	40/2	100/2	75/1
soil crustose lichens	100/2	60/2	33/3	50/2
unknown lichen	50/15	-	-	-
N	2	5	3	4

Wet flood plain depressions

Structure: open tall or low scrub/graminoids
Major taxa: *Salix spp., Vaccinium uliginosum, Calamagrostis canadensis*
Setting: Abandoned channels, oxbow depressions, and shores of small lakes on flood plains
Map unit components: Fc2, Fr5
Soils: Typic Cryaquents (Chapter 6)
Succession: Probably disrupted by intermittent ponding of water and fluctuations in the water table. Post-fire succession on these sites is unknown due generally low flammability of the vegetation.
Comment: This is a poorly defined site type that includes various wetness conditions. In general, these sites have periodically saturated soils, occasional ponding, and a relatively fertile soil (due to periodic inputs of fresh mineral matter with floods). Thus many plants are wetness-tolerant and nutrient-demanding deciduous shrubs and herbs. Sites are dominated by plants that tolerate wetness (*Salix spp., Vaccinium uliginosum, Calamagrostis canadensis*), but also includes some upland species. The vegetation composition is probably always in flux due to colonization between ponding events that eliminate upland species.

Vegetation and ground cover summary *(const - constancy, % of sample stands where present; cover - mean percent cover in stands where present; N - sample size)*

NAME	CONST/COVER
Litter	100/50
Soil	75/11
Water	50/45
TREES	
Betula papyrifera	13/15
Betula papyrifera X B. glandulosa	13/3
Picea glauca	50/18
Picea mariana	38/6
SHRUBS	
Alnus crispa	13/15
Andromeda polifolia	13/1
Betula glandulosa	50/33
Chamaedaphne calyculata	38/7
Empetrum nigrum	38/3
Juniperus communis	13/3
Ledum palustre	38/7
Myrica gale	13/3
Rosa acicularis	13/15
Salix fuscescens	38/15
Salix glauca	13/88
Salix planifolia var. pulchra	63/34
Spiraea beauverdiana	25/9
Vaccinium uliginosum	63/56
Vaccinium vitis-idaea	38/3

NAME	CONST/COVER
GRAMINOIDS	
Agrostis spp.	13/15
Calamagrostis canadensis	63/46
Carex aquatilis	25/52
Carex rostrata	13/38
Carex spp.	38/7
Eriophorum vaginatum	13/88
FORBS	
Cornus canadensis	25/9
Epilobium angustifolium	13/3
Equisetum arvense	25/9
Equisetum fluviatile	25/27
Equisetum pratense	25/8
Equisetum sylvaticum	13/3
Equisetum variegatum	25/15
Erigeron spp.	13/1
Galium boreale	13/15
Iris setosa	13/15
Parnassia palustris	13/3
Polygonum alaskanum	13/1
Potentilla palustris	63/7
Ranunculus lapponicus	13/1
Rubus arcticus	50/21
Rubus chamaemorus	50/6
Thalictrum sparsiflorum	13/3
Trientalis europaea	13/38
unknown forb	25/1
MOSSES	
moss (total)	100/34
Aulocomnium palustre	63/8
Dicranum spp.	25/9
Drepanocladus spp.	25/2
Hylocomium splendens	25/27
Mniumm spp.	13/1
Pleurozium schreberi	25/21
Polytrichum spp.	50/5
Rhizomnium spp.	13/3
Sphagnum spp.	50/12
Tomenthypnum nitens	13/3
unknown moss	50/6

NAME	CONST/COVER
LICHENS	
lichen (total)	63/7
Bryoria spp.	25/2
Cladina rangiferina	25/1
Cladina stellaris	13/1
Cladonia spp.	38/3
Nephroma arcticum	13/1
Peltigera spp.	38/2
arboreal crustose lichens	50/2
soil crustose lichens	13/3
N	8

Wet, nearly level areas with peat on moraines

Structure: needleleaf woodland/open low scrub/graminoids/moss

Major taxa: *Picea mariana, Ledum palustre, Vaccinium uliginosum, Carex spp., Eriophorum vaginatum, Sphagnum spp.*

Setting: Wide, flat crests of glacial moraines

Map unit components: Ko5

Soils: Cryaquepts (Chapter 6)

Succession: Unknown due to small sample size and light burning of observed sites. Vascular plants probably resprout or reseed and reach pre-burn cover values within a few decades after fire, while *Cladina* lichens should return slowly over a century or more.

Comment: Very nutrient-poor sites due to the thick organic soil layer and a landscape position which prevents nutrient inputs with groundwater or floods. Hence vegetation is dominated by nutrient-conserving ericaceous shrubs, *Rubus chamaemorus*, *Sphagnum* moss, and lichens. Resembles "Peat plateau" site type, except that drainage is better and the rooting zone may include a little mineral soil here but not on pleat plateaus.

Vegetation and ground cover summary *(const - constancy, % of sample stands where present; cover - mean percent cover in stands where present; N - sample size)*

NAME	CONST/COVER
Litter	100/23
Soil	100/7
Water	100/6
TREES	
Picea mariana	100/11
SHRUBS	
Betula glandulosa	100/11
Chamaedaphne calyculata	67/3
Empetrum nigrum	67/9
Ledum palustre	100/63
Oxycoccus microcarpus	100/3
Vaccinium uliginosum	100/35
Vaccinium vitis-idaea	100/15
GRAMINOIDS	
Carex bigelowii	33/38
Carex spp.	33/15
Eriophorum vaginatum	67/15
FORBS	
Pedicularis labradorica	33/1
Rubus chamaemorus	100/55

NAME	CONST/COVER
MOSSES	
moss (total)	100/80
Dicranum spp.	67/2
Pleurozium schreberi	33/15
Polytrichum spp.	100/15
Sphagnum spp.	100/63
unknown moss	67/2
LICHENS	
lichen (total)	100/46
Bryoria spp.	100/7
Cetraria (dark color)	67/8
Cetraria cucullata	67/3
Cladina mitis	33/15
Cladina rangiferina	67/27
Cladina stellaris	67/27
Cladonia spp.	100/15
Nephroma arcticum	67/3
Peltigera spp.	33/3
arboreal crustose lichens	67/2
soil crustose lichens	67/8
N	3

Glossary

Active layer. The top layer of ground subject to annual thawing and freezing in areas underlain by permafrost.

Alluvium. Unconsolidated clastic material deposited by running water.

Clay. Mineral soil particles less than 0.002 mm in diameter.

Cobble. Rock fragment 7.6 to 25 cm in diameter.

Colluvium. Unconsolidated earth material on and at the bases of slopes and deposited by mass wasting (direct gravitational action) and local unconcentrated runoff.

Constancy. Occurrence of a plant taxon in stands of approximately equal size. In this study, constancy is calculated as the percent of all intensive transect stops in a vegetation site type where a taxon was recorded.

Cover. Canopy cover by a plant taxon. The entire area within the extent of a plant's canopy is considered to be cover, including minor gaps. Also, the proportion of the gound surface covered by rock, soil, or water.

Creep. Slow, grain-by-grain, downslope movement of soil. Soil particles are displaced by freeze-thaw or biotic activity and settle downslope from their original positions.

Cryoturbation. Soil movements due to frost action, characterized by folded, broken, and dislocated beds or soil horizons.

Drainage, soil. The frequency and duration of saturation or partial saturation in a soil. Classes include excessively drained, well drained, moderately well drained, somewhat poorly drained, poorly drained, and very poorly drained.

Earth hummock. A hummock having a core of silty or clayey mineral soil and showing evidence of cryoturbation.

Ecotone. A transitional zone between major ecosystems such as forest and tundra.

Fen. A minerotrophic wetland with a peat soil.

Flood plain. A nearly level plain bordering a stream, constructed by the river and subject to flooding.

Gley. Gray or mottled soil due to reduction of iron and other metals under water-saturated, anaerobic conditions.

Gravel. Fragments of rock from 0.2 to 7.6 cm in diameter.

Groundwater discharge. Release of water to the surface from saturated soil or rock.

Groundwater recharge. Absorption and addition of water to the subsurface zone of saturated soil or rock.

Holocene. The geologic time period from 10,000 years ago to the present.

Ice-wedge polygon. Patterned ground in areas of ice wedges.

Icing. A surface ice mass formed by successive freezing of sheets of overflowing water.

Loam. Soil composed of a mixture of sand, silt, and clay. Silt loam is dominantly silt, powdery when dry and smooth but not sticky when wet. Sandy loam is up to one-half sand and feels gritty.

Loess. Fine-grained wind-deposited material, mainly silt.

Low-chroma. Said of grayish colors that have chroma less than 2 on a standard Munsell soil color chart. Low-chroma mottles (spots occupying less than half of the soil) and low-chroma matrix (occupying more than half of the soil) are often used to indicate the oxidation-reduction state of a soil and, by inference, its wetness.

Minerotrophic. Rich in mineral nutrients and moderately acidic to alkaline (pH > 5). Used to describe wetlands.

Moraine. A landform composed of sediment deposited directly by glacial ice.

Muck. A mass of highly decomposed organic matter.

Mudboil. Circular, vegetation-free patch, approximately 1 m in size, formed by frost action.

Outwash, glacial. Stratified detritus (chiefly sand and gravel) removed or "washed out" from a glacier by meltwater streams.

Palsa. An elliptical domelike permafrost mound containing alternating layers of ice lenses and peat or mineral soil, commonly 3-5 m high and 2-25 m long, surrounded by fen or water.

Parent material. The original geologic material from which a soil forms.

Peat. A mass of slightly decomposed organic matter.

Peat plateau. A generally flat expanse of peat, elevated above associated thermokarst depressions and containing segregated ice.

Permafrost. Ground, soil, or rock that remains at or below 0 C for at least two years.

Permeability. The ability of rock or soil to transmit fluid.

Pleistocene. The geologic time period from approximately 2 million to 10 thousand years ago.

Podzolization. A soil-forming process whereby complexes of organic matter, iron, and aluminum are leached from upper soil horizons and deposited lower in the soil profile.

Redoximorphic. Refers to features in the soil that indicate oxidation and reduction of metals such as iron and manganese. Example features include low-chroma mottles and low-chroma matrix.

Reduction, biochemical. A change of a chemical element from oxidized to reduced state by the action of microorganisms under anaerobic (oxygen-free) conditions.

Ribbed fen. A fen (minerotrophic wetland) with roughly parallel, low, peat ridges alternating with wetter hollows. Also known as a string fen or patterned fen.

Sand. Soil particles 0.05 to 2 mm in size. Sand is large enough to be visible to the naked eye and feels gritty. Also, a soil dominated by particles of this size. Loamy sand has at least 10% but less than 30% finer material in addition to sand.

Segregated ice. Lenses or layers of ice in the ground formed by drawing of water to a freezing front.

Silt. Soil particles intermediate in size between clay and sand (0.002 to 0.05 mm). Also, a soil dominated by particles of this size.

Solifluction. Slow, viscous downslope flow of water-saturated material, usually over frozen material.

Substratum. Material occurring deep in a soil or under it, below a depth of 1 m.

Succession. Change in a biotic assemblage over time after disturbance or a change in site conditions.

Talik. Permanently unfrozen ground in a permafrost region.

Terrace, stream. A nearly level surface bordered at least in part by an escarpment and representing the former position of a flood plain.

Texture, soil. The proportion of sand, silt, and clay in a soil.

Thermokarst. Subsidence, collapse, and erosion due to local melting of ground ice.

Throughflow. Lateral movement of water in the soil as shallow ephemeral perched groundwater.

Till, glacial. Dominantly unsorted and unstratified material deposited by a glacier.

Treethrow. Displacement of soil with a root mat when a tree falls over.

Tussock. A small mound or tuft 0.1-0.5 m in height and diameter, composed of organic matter and produced by certain moisture-loving grass-like plants such as *Eriophorum* (cottonsedge).

Water table. The surface of a body of unconfined groundwater.

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Appendix I: Plant List

Symbol[1]	Plant name
ACDE2	Aconitum delphiniifolium DC.
AGROP2	Agropyron Gaertn.
AGROS2	Agrostis L.
ALCR6	Alnus crispa (Ait.) Pursh
ALIN2	Alnus incana (L.) Moench
ALOC60	Alectoria ochroleuca (Hoffm.) Massal.
ALSC	Allium schoenoprasum L.
ANFR	Antennaria friesiana (Trautv.) Ekman
ANNA	Anemone narcissiflora L.
ANPO	Andromeda polifolia L.
ARAL2	Arctostaphylos alpina (L.) Spreng.
ARAR9	Artemisia arctica Less.
ARCTA	Arctagrostis Griseb.
ARCTO3	Arctostaphylos Adans.
ARFR2	Arnica frigida C.A. Mey. ex Iljin
ARLA2	Arctagrostis latifolia (R. Br.) Griseb.
ARRU	Arctostaphylos rubra (Rehd. & Wilson) Fern.
ARTI	Artemisia tilesii Ledeb.
ASAL7	Astragalus alpinus L.
ASSI	Aster sibiricus L.
AUPA70	Aulacomnium palustre (Hedw.) Schwaegr.
AUTU70	Aulacomnium turgidum (Wahlenb.) Schwaegr.
BEGL	Betula glandulosa Michx.
BEGLXPA	Betula glandulosa - B. Papyrifera hybrid
BENA	Betula nana L.
BEPA	Betula papyrifera Marsh.
BEPAXGL	Betula papyrifera - B. glandulosa hybrid
BORO	Boschniakia rossica (Cham. & Schlecht.) Fedtsch.
BRYOR2	Bryoria Brodo & D. Hawksw.
BRYUM70	Bryum Hedw.
BUTRA2	Bupleurum triradiatum ssp. arcticum (Regel) Hulten
CAAQ	Carex aquatilis Wahlenb.
CABI5	Carex bigelowii Torr. ex Schwein.
CACA11	Carex canescens L.
CACA20	Castilleja caudata (Pennell) Rebr.
CACA4	Calamagrostis canadensis (Michx.) Beauv.[2]
CAHY6	Castilleja hyperborea Pennell
CALA7	Campanula lasiocarpa Cham.
CALAM	Calamagrostis Adans.
CALI7	Carex limosa L.
CAMA12	Carex magellanica Lam.
CAMPY3	Campylium (Sull.) Mitt.
CAPU	Calamagrostis purpurascens R. Br.

Symbol[1]	Plant name
CAREX	Carex L.
CARO6	Carex rostrata Stokes
CASTI2	Castilleja Mutis ex L. f.
CATE11	Cassiope tetragona (L.) D. Don
CECU60	Cetraria cucullata (Bellardi) Ach.
CEDK	dark-colored Cetraria[3]
CEIS60	Cetraria islandica (L.) Ach.
CENI62	Cetraria nivalis (L.) Ach.
CHCA2	Chamaedaphne calyculata (L.) Moench
CIMA	Cicuta mackenzieana Raup
CLADO3	Cladonia Hill ex Browne
CLMI60	Cladina mitis (Sandst.) Hustich[4]
CLRA60	Cladina rangiferina (L.) Nyl.
CLST60	Cladina stellaris (Opiz) Brodo
COCA13	Cornus canadensis L.
COSE5	Corydalis sempervirens (L.) Pers.
CRUST	crustose and soil crust lichens
CYFR2	Cystopteris fragilis (L.) Bernh.
CYPA5	Cypripedium passerinum Richards.
DAAR60	Dactylina arctica (Richardson) Nyl.
DACTY4	Dactylina Nyl.
DICRA8	Dicranum Hedw.
DOFR	Dodecatheon frigidum Cham. & Schlecht.
DRAN	Drosera anglica Huds.
DRDI2	Dryopteris dilatata auct. non (Hoffmann) Gray
DREPA3	Drepanocladus (C.Mull.) G.Roth
DRFR	Dryopteris fragrans (L.) Schott
DROC	Dryas octopetala L.
DRRO	Drosera rotundifolia L.
DRYAS	Dryas L.
ELQU2	Eleocharis quinqueflora (F.X. Hartmann) Schwarz
EMNI	Empetrum nigrum L.
EPAN2	Epilobium angustifolium L.
EPLA	Epilobium latifolium L.
EQAR	Equisetum arvense L.
EQFL	Equisetum fluviatile L.
EQPR	Equisetum pratense Ehrh.
EQSC	Equisetum scirpoides Michx.
EQSY	Equisetum sylvaticum L.
EQVA	Equisetum variegatum Schleich. ex F. Weber & D.M.H. Mohr
ERAN6	Eriophorum angustifolium Honckeny
ERBR6	Eriophorum brachyantherum Trautv. & C.A. Mey.
ERIGE2	Erigeron L.
ERIOP	Eriophorum L.
ERRU2	Eriophorum russeolum Fries ex Hartman
ERVA4	Eriophorum vaginatum L.

Symbol[1]	Plant name
FEAL	Festuca altaica Trin.
GABO2	Galium boreale L.
GEGL	Gentiana glauca Pallas
GELI2	Geocaulon lividum (Richards.) Fern.
GEPR7	Gentiana propinqua Richards.
GYDR	Gymnocarpium dryopteris (L.) Newman
HEAL	Hedysarum alpinum L.
HIAL3	Hierochloe alpina (Sw. ex Willd.) Roemer & J.A. Schultes
HYSP70	Hylocomium splendens (Hedw.) Schimp. in B.S.G.
IRSE	Iris setosa Pallas ex Link
JUCO6	Juniperus communis L.
JUTR4	Juncus triglumis L.
LEPA11	Ledum palustre L.
LIBO3	Linnaea borealis L.
LICHEN	total lichen
LITTER	litter/mulch
LIVER	Hepaticae (liverworts), mainly Marchantia
LOPR	Loiseleuria procumbens (L.) Desv.
LUAR2	Lupinus arcticus S. Wats.
LUCO5	Luzula confusa Lindeberg
LUMU2	Luzula multiflora (Ehrh.) Lej.
LYAL3	Lycopodium alpinum L.
LYAN2	Lycopodium annotinum L.
LYCL	Lycopodium clavatum L.
LYCO3	Lycopodium complanatum L.
LYOBD	Lycopodium obscurum var. dendroideum (Michx.) D.C. Eat.
LYSE	Lycopodium selago L.
MARI60	Masonhalea richardsonii (Hook.) Karnef.
MEPA	Mertensia paniculata (Ait.) G. Don
METR3	Menyanthes trifoliata L.
MIAR3	Minuartia arctica (Stev. ex Ser.) Graebn.
MNIUM2	Mnium Hedw.
MOSS	total bryophytes
MOUN2	Moneses uniflora (L.) Gray
MYGA	Myrica gale L.
NEAR60	Nephroma arcticum (L.) Torss.
NUPO2	Nuphar polysepala Engelm.
OXMI3	Oxycoccus microcarpos Turcz. ex Rupr.
OXYTR	Oxytropis DC.
PAPA8	Parnassia palustris L.
PEDIC	Pedicularis L.
PEFR5	Petasites frigidus (L.) Fries
PEHY5	Petasites hyperboreus Rydb.
PEKA7	Pedicularis kanei Dur.
PELA	Pedicularis labradorica Wirsing
PELTI2	Peltigera Willd.

Symbol[1]	Plant name
PEVE	Pedicularis verticillata L.
PIGL	Picea glauca (Moench) Voss
PIMA	Picea mariana (P. Mill.) B.S.P.
PLHY2	Platanthera hyperborea (L.) Lindl.
PLOB	Platanthera obtusata (Banks ex Pursh) Lindl.
PLSC70	Pleurozium schreberi (Brid.) Lindb.
POA	Poa L.
POAC	Polemonium acutiflorum Willd. ex Roemer & J.A. Schultes
POAL5	Polygonum alaskanum W. Wight ex Hulten
POBA2	Populus balsamifera L.
POBO2	Polemonium boreale M.F. Adams
POFR4	Potentilla fruticosa auct. non L.
POLYT5	Polytrichum Hedw.
POPA14	Potentilla palustris (L.) Scop.
POPER5	Potamogeton perfoliatus ssp. richardsonii (Benn.) Hulten
POPR5	Potamogeton praelongus Wulfen
POTR5	Populus tremuloides Michx.
POVA4	Potentilla vahliana Lehm.
POVI3	Polygonum viviparum L.
PSEUD33	Pseudephebe M. Choisy
PTCR70	Ptilium crista-castrensis (Hedw.) De Not.
PYAS	Pyrola asarifolia Michx.
PYGR	Pyrola grandiflora Radius
PYSE	Pyrola secunda L.
RALA	Ranunculus lapponicus L.
RALA70	Racomitrium lanuginosum (Hedw.) Brid.
RHIZO2	Rhizomnium (Broth.) T.Kop.
RHRU70	Rhytidium rugosum (Hedw.) Kindb.
RHTR70	Rhytidiadelphus triquetrus (Hedw.) Warnst.
RITR	Ribes triste Pallas
ROAC	Rosa acicularis Lindl.
ROCK	rock fragments
RUAR	Rubus arcticus L.
RUAR6	Rumex arcticus Trautv.
RUCH	Rubus chamaemorus L.
SAAL	Salix alaxensis (Anderss.) Coville
SAAN3	Saussurea angustifolia (Willd.) DC.
SAAR4	Salix arctica Pallas
SABRF	Saxifraga bronchialis ssp. funstonii (Small) Hulten
SAFU	Salix fuscescens Anderss.
SAGL	Salix glauca L.
SALA4	Salix lanata L.
SALAR	Salix lanata ssp. richardsonii (Hook.) Skvort.
SAOF3	Sanguisorba officinalis L.
SAPH	Salix phlebophylla Anderss.
SAPLP	Salix planifolia ssp. pulchra (Cham.) Argus

Symbol[1]	Plant name
SAPLXGL	Salix planifolia - S. glauca hybrid
SAPLXLA	Salix planifolia - S. lanata hybrid
SAPO	Salix polaris Wahlenb.
SAPU6	Saxifraga punctata L. p.p.
SARE2	Salix reticulata L.
SARE8	Saxifraga reflexa Hook.
SEROI3	Sedum rosea ssp. integrifolium (Raf.) Hulten
SESI	Selaginella sibirica (Milde) Hieron.
SHCA	Shepherdia canadensis (L.) Nutt.
SOIL	bare soil
SOMU	Solidago multiradiata Ait.
SPAN2	Sparganium angustifolium Michx.
SPBE	Spiraea beauverdiana auct. non Schneid.
SPHAG2	Sphagnum L.
SPLU70	Splachnum luteum Hedw.
SPWA70	Sphagnum warnstorfii Russ.
STELL	Stellaria L.
STERE2	Stereocaulon Hoffm.
THAMN3	Thamnolia Ach. ex Schaerer
THSP	Thalictrum sparsiflorum Turcz. ex Fisch. & C.A. Mey.
TONI70	Tomentypnum nitens (Hedw.) Loeske
TOPU	Tofieldia pusilla (Michx.) Pers.
TRAL7	Trichophorum alpinum (L.) Pers.
TREU	Trientalis europaea L.
TRMA4	Triglochin maritimum L.
USNEA2	Usnea Dill. ex Adans.
VACA3	Valeriana capitata Pallas ex Link
VAUL	Vaccinium uliginosum L.
VAVI	Vaccinium vitis-idaea L.
VIED	Viburnum edule (Michx.) Raf.
VIEP	Viola epipsila Ledeb.
VIOLA	Viola L.
WATER	standing water
WIPH	Wilhelmsia physodes (Fisch. ex Ser.) McNeill
ZIEL2	Zigadenus elegans Pursh
ZZFORB	unknown forb
ZZGRASS	unknown grass
ZZLICHEN	unknown lichen
ZZMOSS	unknown moss
ZZSEDGE	unknown sedge (Cyperaceae)

[1] Symbols used in database

[2] *Calamagrostis canadensis* may include some *C. inexpansa* or *C. lapponica*

[3] Dark-colored *Cetraria* may include *C. islandica, C. ericetorium, C laevigata, C. delisei,* or *C. Kamczatica*

[4] *Cladina mitis* probably includes some *C. arbuscula*

Appendix II: Soil Rating Criteria

Soil suitability ratings for various purposes were made according to the SCS guidelines reproduced in Tables 17 through 28 of this appendix. Standard ratings were adjusted as shown below to better reflect conditions in the study area.

Camp Areas (Table 17)

Modification: replace item 2 with:

PROPERTY	LIMITS			RESTRICTIVE FEATURE
	SLIGHT	MODERATE	SEVERE	
Flooding	NONE	OCCAS, RARE	FREQUENT	FLOODING

Justification: flooded areas lack permafrost and thus are among the few areas dry enough for campsites; primitive National Park Service campgrounds are not severely limited by occasional flooding

Camp Areas (Table 17); **Picnic Areas** (Table 22); **Paths and trails** (Table 21)

Modification: when the property UNIFIED (SURFACE) is PT, replace the restrictive feature EXCESS HUMUS with FRAGILE

Justification: organic surface soil is unsuitable mainly because it is fragile (subject to degradation under traffic)

Off-road Vehicle Trails (Table 20)

Modification: when the property UNIFIED (SURFACE) is PT, replace the restrictive feature EXCESS HUMUS with FRAGILE

Justification: organic surface soil is unsuitable mainly because it is fragile (subject to degradation under traffic)

Modification: delete item 1; add:

PROPERTY	LIMITS			RESTRICTIVE FEATURE
	SLIGHT	MODERATE	SEVERE	
Risk of thaw subsidence	LOW	-	MODERATE, HIGH	SUBSIDES

Justification: thaw subsidence is a major hazard on primitive roads

Local Roads (Table 19); Small Buildings (Table 27)

Modification: delete item 1; add:

PROPERTY	LIMITS			RESTRICTIVE FEATURE
	SLIGHT	MODERATE	SEVERE	
Risk of thaw subsidence	LOW	-	MODERATE, HIGH	SUBSIDES
Icing hazard	LOW	MODERATE	HIGH	ICING

Justification: permafrost is a problem for unexcavated foundations only if thaw subsidence occurs; icing is a major hazard in cold climates.

Roadfill (Table 23)

Modification: add:

PROPERTY	LIMITS			RESTRICTIVE FEATURE
	SLIGHT	MODERATE	SEVERE	
AASHTO CLASS	-	A-4, A-5, A-6, A-7	-	FROST SUSCEPTIBLE

Justification: at least 1 m (or 0.5 m if a geotextile is used) of non-frost-susceptible material is needed for road embankments in most areas.

Septic Tank Absorption Fields (Table 25)

Modification: the depth used in item 8 is 1.0-1.5 m
Justification: septic systems must be placed deeper than 1 m to avoid freezing.

TABLE 17: SOIL RATING CRITERIA FOR CAMP AREAS

	PROPERTY	LIMITS			RESTRICTIVE FEATURE
		SLIGHT	MODERATE	SEVERE	
1.	USDA TEXTURE	—	—	ICE	PERMAFROST
1a.	TEXTURE MODIFIER (SURFACE)	—	STV, BYV CB, FL CBV, FLV, CNX	STX, BYX, CBX, FLX,	TOO COBBLY
1b.	TEXTURE (SURFACE LAYER)	—	—	SC, SIC, C	TOO CLAYEY
1c.	TEXTURE (SURFACE LAYER) TOR, UST, ARID, XER, OXI SUBORDERS, GREAT GROUPS, AND SUBGROUPS, OXISOLS	—	SC, SIC, C	—	TOO CLAYEY
1d.	TEXTURE (SURFACE LAYER, FINER MATERIAL <20")	LFS, LS	LCOS, VFS	COS, S, FS	TOO SANDY
1e.	TEXTURE (TOR, ARID, OR XER SUBGROUPS & GREAT GROUPS)	—	SIL, SI, VFSL, L, ASHY	—	DUSTY
2.	FLOODING	NONE	—	RARE, OCCAS, FREQ,	FLOODING
3.	SLOPE (PCT)	<8	8-15	>15	SLOPE
4.	PONDING	—	—	+	PONDING
5.	DEPTH TO HIGH WATER TABLE (FT)	>2.5	1.5-2.5	<1.5	WETNESS
6.	STONINESS CLASS	1	2	3, 4, 5	TOO STONY
7.	WEIGHT PERCENT 2 mm-3" (SURFACE LAYER)	<25	25-50	>50	TOO GRAVELLY
8.	PERMEABILITY (0-40", IN/H))	>0.6	0.06-0.6	<0.06	PERCS SLOWLY
8a.	PERMEABILITY (0-40", IN/H; TOR, UST, ARID, XER, OXI SUBORDERS, GREAT GROUPS AND SUBGROUPS, OXISOLS)	≥0.2	<0.2		PERCS SLOWLY
9.	UNIFIED (SURFACE)	—	—	PT	EXCESS HUMUS
10.	DEPTH TO BEDROCK (IN)			<20	DEPTH TO ROCK
11.	DEPTH TO CEMENTED PAN (IN)			<20	CEMENTED PAN
12.	SODIUM ADSORPTION RATIO	<4	4-13	>13	
13.	SALINITY (SURFACE LAYER, MMHOS/CM)	<4	4-8	>8	EXCESS SALT
14.	SOIL REACTION (pH)	—	—	<3.5	TOO ACID

TABLE 18: SOIL RATING CRITERIA FOR GRAVEL

	PROPERTY	LIMITS		RESTRICTIVE FEATURE
		PROBABLE SOURCE	IMPROBABLE SOURCE	
1.	USDA TEXTURE	---	ICE	PERMAFROST
2.	UNIFIED (THICKEST LAYER 10-60" OR BOTTOM LAYER)	GW, GP, GW-GM, GP-GM		FAVORABLE
2a.	UNIFIED (THICKEST LAYER 10-60" OR BOTTOM LAYER 100 - % PASSING # 4 SIEVE = >25)	SW, SP, SW-SM, SP-SM		FAVORABLE
2b.	UNIFIED (THICKEST LAYER 10-60", OR BOTTOM LAYER, 100% PASSING #4 SIEVE <25)		SW, SP, SW-SM, SP-SM	TOO SANDY
2c.	UNIFIED	-	PT	EXCESS HUMUS
2d.	UNIFIED		ALL OTHER	EXCESS FINES
3.	LAYER THICKNESS (0-72 IN)	>36	<36	THIN LAYER
4.	WEIGHT PERCENT 3-10" (THICKEST LAYER 10-60")	<50	>50	TOO COBBLY
4a.	WEIGHT PERCENT >10" (THICKEST LAYER 10-60")	<15	>15	TOO STONY

TABLE 19: SOIL RATING CRITERIA FOR LOCAL ROADS

	PROPERTY	LIMITS			RESTRICTIVE FEATURE
		SLIGHT	MODERATE	SEVERE	
1.	USDA TEXTURE	---	—	ICE	PERMAFROST
2.	TOTAL SUBSIDENCE (IN)	---	—	>12	SUBSIDES
3.	DEPTH TO HARD BEDROCK (IN)	>40	20-40	<20	DEPTH TO ROCK
3a.	DEPTH TO SOFT BEDROCK (IN)	>20	<20	–	DEPTH TO SOFT ROCK
4.	DEPTH TO CEMENTED PAN THICK (IN)	>40	20-40	<20	CEMENTED PAN
4a.	DEPTH TO CEMENTED PAN THIN (IN)	>20	<20	—	CEMENTED PAN
5.	SHRINK-SWELL (THICK LAYER 10-40", PCT)	<3	3-6	>6	SHRINK-SWELL
6.	AASHTO GROUP INDEX NUMBER (THICKEST LAYER 10-40")	<5	5-8	>8	LOW STRENGTH
6a.	AASHTO CLASS	---	A-6	A-7,A-8	LOW STRENGTH
7.	PONDING	---	—	+	PONDING
8.	DEPTH TO HIGH WATER TABLE (FT)	>2.5	1.0-2.5	<1.0	WETNESS
9.	GYPSUM (PCT)	<5	5-15	>15	EXCESS GYPSUM
9a.	GYPSUM (PCT)			>40	SUBSIDES,
10.	SLOPE (PCT)	<8	8-15	>15	SLOPE
11.	FLOODING	NONE	RARE	FREQ, OCCAS	FLOODING
12.	POTENTIAL FROST ACTION	LOW	MODERATE	HIGH	FROST ACTION
13.	WEIGHT PERCENT 3-10" (WEIGHT AV. 0-40")	<25	25-50	>50	TOO COBBLY
13a.	WEIGHT PERCENT >10" (WEIGHT AV. 0-40")	<5	5-15	>15	TOO STONY

TABLE 20: SOIL RATING CRITERIA FOR OFF-ROAD VEHICLE TRAILS

	PROPERTY	LIMITS			RESTRICTIVE FEATURE
		SLIGHT	MODERATE	SEVERE	
1.	USDA TEXTURE	---	---	ICE	PERMAFROST
1a.	TEXTURE MODIFIER (SURFACE)	—	STV, BYV	STX, BYX, CBX, FLX, CBV, FLV, CNX	TOO COBBLY
1b.	TEXTURE (SURFACE LAYER)	—	---	SC, SIC, C	TOO CLAYEY
1c.	TEXTURE (SURFACE LAYER; TOR, UST, ARID, XER, OXI SUBORDERS, GREAT GROUPS, AND SUBGROUPS, OXISOLS)	---	SC, SIC, C	—	TOO CLAYEY
1d.	TEXTURE (SURFACE LAYER FINER MATERIAL ≥ 20")	—	LCOS, VFS, LFS, LS	COS, S, FS	TOO SANDY
1e.	TEXTURE (SURFACE LAYER, FINER MATERIAL <20")	LFS, LS	LCOS, VFS	COS, S, FS	TOO SANDY
1f.	TEXTURE (SURFACE LAYER; TOR, ARID, OR XER SUBGROUPS & GREAT GROUPS	—	SIL, SI,	— VFSL, L, ASHY	DUSTY
2.	STONINESS CLASS	1	2	3, 4, 5	TOO STONY
3.	PONDING	—	---	+	PONDING
4.	DEPTH TO HIGH WATER TABLE (FT)	>2	1-2	<1	WETNESS
5.	UNIFIED (SURFACE)	---	---	PT	EXCESS HUMUS
6.	SLOPE (PCT)	<25	25-40	>40	SLOPE
7.	WEIGHT PERCENT 2 mm-3" (SURFACE LAYER)			>65	SMALL STONES
8.	FLOODING	NONE, RARE, OCCAS.	FREQ.	---	FLOODING

TABLE 21: SOIL RATING CRITERIA FOR PATHS AND TRAILS

PROPERTY	LIMITS			RESTRICTIVE FEATURE
	SLIGHT	MODERATE	SEVERE	
1. USDA TEXTURE	—	—	ICE	PERMAFROST
1a. TEXTURE MODIFIER (SURFACE)	—	STV, BYV	STX, BYX, CBX, FLX, CBV, FLV, CNX	TOO COBBLY
1b. TEXTURE (SURFACE LAYER)	—	—	SC, SIC, C	TOO CLAYEY
1c. TEXTURE (SURFACE LAYER; TOR, UST, ARID, BOR, OR XER SUBORDERS, GREAT GROUPS, AND SUBGROUPS)	—	SC, SIC, C	—	TOO CLAYEY
1d. TEXTURE (SURFACE LAYER)	—	LCOS, VFS, LFS, LS	COS, S, FS	TOO SANDY
1e. TEXTURE (SURFACE LAYER, FINER MATERIAL <20")	LFS, LS	LCOS, VFS	COS, S, FS	TOO SANDY
1f. TEXTURE (SURFACE LAYER; TOR, ARID, OR XER SUBGROUPS & GREAT GROUPS)	—	SIL, SI, VFSL, L	—	DUSTY
2. STONINESS CLASS	1	2	3, 4, 5	TOO STONY
3. PONDING	—	—	+	PONDING
4. DEPTH TO HIGH WATER TABLE (FT)	>2	1-2	<1	WETNESS
5. UNIFIED (SURFACE)	—	—	PT	EXCESS HUMUS
6. SLOPE (PCT)	<15	15-25	>25	SLOPE
7. WEIGHT PERCENT 2 mm-3" (SURFACE LAYER)	—	—	>65	SMALL STONES
8. WEIGHT PERCENT >3" (SURFACE LAYER)	<25	25-50	>50	LARGE STONES
9. FLOODING	NONE, RARE, OCCAS	FREQ	—	FLOODING
10. EROSION FACTOR (K) (SURFACE LAYER) ON SLOPES >8%	—	—	>.35	ERODES EASILY

TABLE 22: SOIL RATING CRITERIA FOR PICNIC AREAS

	PROPERTY	LIMITS			RESTRICTIVE FEATURE
		SLIGHT	MODERATE	SEVERE	
1.	USDA TEXTURE	—	—	ICE	PERMAFROST
1a.	TEXTURE (MODIFIER SURFACE)	—	STV, BYV	STX, BYX, CBX, FLX CBV, FLV CNX	TOO COBBLY
1b.	TEXTURE (SURFACE LAYER)	—	—	SC, SIC, C	TOO CLAYEY
1c.	TEXTURE (SURFACE LAYER- TOR, UST, ARID, BOR, XER, OXI SUBORDERS, GREAT GROUPS, AND SUBGROUPS, OXISOLS)	—	SC, SIC, C	—	TOO CLAYEY
1d.	TEXTURE (SURFACE LAYER FINER MATERIAL ≥ 20")	—	LCOS, VFS, LFS, LS	COS, S, FS	TOO SANDY
1e.	TEXTURE (SURFACE LAYER, FINER MATERIAL <20")	LFS, LS	LCOS, VFS,	COS, S, FS	TOO SANDY
1f.	TEXTURE (SURFACE LAYER-TOR, ARID, OR XER SUBGROUPS & GREAT GROUPS	—	SIL, SI, VFSL, L, ASHY	—	DUSTY
2.	SLOPE (PCT)	<8	8-15	>15	SLOPE
3.	FLOODING	NONE, RARE, OCCAS.	FREQ.		FLOODING
4.	PONDING	—	—	+	PONDING
5.	DEPTH TO HIGH WATER TABLE (FT)	>2.5	1.0-2.5	<1.0	WETNESS
6.	PERMEABILITY (0-40", IN/H)	>0.6	0.06-0.6	<0.06	PERCS SLOWLY
6a.	PERMEABILITY (0-40"- TOR, UST, ARID, BOR, XER, OXI SUBORDERS, GREAT GROUPS AND SUBGROUPS, OXISOLS)	≥0.2	<0.2		PERCS SLOWLY
7.	STONINESS CLASS	1	2	3, 4, 5	TOO STONY
8.	UNIFIED (SURFACE)	—	—	PT	EXCESS HUMUS
9.	WEIGHT PERCENT 3-10" (SURFACE LAYER)	<25	25-50	>50	TOO GRAVELLY
10.	SODIUM ADSORPTION RATIO	<4	4-13	>13	EXCESS SODIUM
11.	SALINITY (SURFACE LAYER, MMHOS/CM)	<4	4-8	>8	EXCESS SALT
12.	SOIL REACTION (pH)	—	—	<3.5	DEPTH TO ROCK
13.	DEPTH TO BEDROCK (IN)			<20	
14.	DEPTH TO CEMENTED PAN (IN)			<20	CEMENTED PAN

(430-VI-NSH, Draft, September 1992)

TABLE 23: SOIL RATING CRITERIA FOR ROADFILL

	PROPERTY	LIMITS			RESTRICTIVE FEATURE
		SLIGHT	MODERATE	SEVERE	
1.	USDA TEXTURE	—	—	ICE	PERMAFROST
2.	DEPTH TO BEDROCK (IN)	>60	40-60	<40	AREA RECLAIM
3.	DEPTH TO CEMENTED PAN (IN)	>60	40-60	<40	CEMENTED PAN
4.	SHRINK-SWELL (THICKEST LAYER 10-60 BEST RATING, (PCT)	<3	3--6	>6	SHRINK-SWELL
5.	AASHTO CLASS	—	A-6	A-7, A-8	LOW STRENGTH
6.	AASHTO GROUP INDEX NUMBER (THICKEST LAYER 10-60" BEST RATING)	<5	5-8	>8	LOW STRENGTH
7.	LAYER THICKNESS (IN)	>60	30-60	<30	THIN LAYER
8.	WEIGHT PERCENT 3-10" (WEIGHTED AVE. TO 40")	<25	25-50	>50	TOO COBBLY
8a.	WEIGHT PERCENT >10" (WEIGHTED AVE. TO 40")	<5	5-15	>15	TOO STONY
9.	DEPTH TO HIGH WATER TABLE (FT)	>3	1-3	<1	WETNESS
10.	GYPSUM (PCT)	<10	10-15	>15	EXCESS GYPSUM
11.	SLOPE (PCT)	<15	15-25	>25	SLOPE

TABLE 24: SOIL RATING CRITERIA FOR SAND

	PROPERTY	LIMITS		RESTRICTIVE FEATURE
		PROBABLE SOURCE	IMPROBABLE SOURCE	
1.	USDA TEXTURE	—	ICE	PERMAFROST
2a.	UNIFIED (THICKEST LAYER 10-60" AND LOWEST LAYER BEST RATING)	SW, SP, SW-SM, SP-SM		
2b.	UNIFIED (THICKEST LAYER 10-60" AND LOWEST LAYER BEST RATING) % PASSING # 4 MINUS #200 SIEVE >25	GW, GP, GW-GM, GP-GM		
2c.	UNIFIED (THICKEST LAYER 10-60 AND LOWEST LAYER BEST RATING) % PASSING # 4 MINUS #200 SIEVE <25		GW, GP, GW-GM, GP-GM	SMALL STONES
2d.	UNIFIED		PT	EXCESS HUMUS
2e.	UNIFIED		ALL OTHER	EXCESS FINES
3.	LAYER THICKNESS (IN)	>36	<36"	THIN LAYER
4.	WEIGHT PERCENT 3-10" (THICKEST LAYER 10-60")	<50	>50	TOO COBBLY
4a.	WEIGHT PERCENT >10" (THICKEST LAYER 10-60")	<15	>15	TOO STONY
5.	MICA CONTENT PASSING #10-200 SIEVE (PCT WT)	<10	>10	NON-DURABLE

TABLE 25: SOIL RATING CRITERIA FOR SEPTIC TANK ABSORPTION FIELDS

	PROPERTY	LIMITS			RESTRICTIVE FEATURE
		SLIGHT	MODERATE	SEVERE	
1.	USDA TEXTURE	---	—	ICE	PERMAFROST
2.	TOTAL SUBSIDENCE (IN)	<12	12-24	>24	SUBSIDES
3.	FLOODING	NONE	RARE	FREQ, OCCAS	FLOODING
4.	DEPTH TO BEDROCK (IN)	>72	40-72	<40	DEPTH TO ROCK
5.	DEPTH TO CEMENTED PAN (IN)	>72	40-72	<40	CEMENTED PAN
6.	PONDING	—	—	+	PONDING
7.	DEPTH TO HIGH WATER TABLE (FT)	>6	4-6	<4	WETNESS
8.	PERMEABILITY (24-60", IN/H)	2.0-6.0	0.6-2.0	<0.6	PERCS SLOWLY
8a.	PERMEABILITY (24-60", IN/H)	---	—	>6.0	POOR FILTER
9.	SLOPE (PCT)	<8	8-15	>15	SLOPE
10.	WEIGHT PERCENT 3-10" (WEIGHTED AV. TO 40")	<25	25-50	>50	TOO COBBLY
10a.	WEIGHT PERCENT >10" (WEIGHTED AV. TO 40")	<5	5-15	>15	TOO STONY

TABLE 26: SOIL RATING CRITERIA FOR SHALLOW EXCAVATIONS

	PROPERTY	LIMITS			RESTRICTIVE FEATURE
		SLIGHT	MODERATE	SEVERE	
1.	DEPTH TO HARD BEDROCK (IN)	>60	40-60	<40	DEPTH TO ROCK
2.	DEPTH TO CEMENTED PAN THICK (IN)	>60	40-60	<40	CEMENTED PAN
2a.	DEPTH TO CEMENTED PAN THIN (IN)	>40	20-40	<20	CEMENTED PAN
3.	USDA TEXTURE	—	—	ICE	PERMAFROST
3a.	TEXTURE (20-60")	—	SI (IF NOT LOESS)	COS, S, FS, VFS, LCOS, LS, LFS, SG, VFS, G	CUTBANKS CAVE
3b.	TEXTURE (20-60") (IF NOT OXIC SUBGROUP, OXISOL, KANDHAPL OR KANDI GREAT GROUP, KAOLINITIC MINERALOGY)	—	SIC, C	—	TOO CLAYEY
4.	SOIL ORDER UNIFIED	—	—	CM,MH VERTISOLS	CUTBANKS CAVE
5.	UNIFIED (20-60")	—	—	OL,OH, PT	EXCESS HUMUS
6.	WEIGHT PERCENT 3-10" (WEIGHTED AV. TO 40")	<25	25-50	>50	TOO COBBLY
6a.	WEIGHT PERCENT >10" (WEIGHTED AV. TO 40")	<5	5-15	>15	TOO STONY
7.	PONDING	—	—	+ ANY ENTRY	PONDING
8.	DEPTH TO HIGH WATER TABLE (FT)	>6	2.5-6	<2.5	WETNESS (DISREGARD IF SUBJECT TO PONDING)
9.	FLOODING	NONE, RARE	COMMON, OCCAS	FREQ	FLOODING
10.	SLOPE (PCT)	<8	8-15	>15	SLOPE
11.	DOWNSLOPE MOVEMENT (SLOPE PCT)	—	—	>15	SLIPPAGE

TABLE 27: SOIL RATING CRITERIA FOR SMALL BUILDINGS

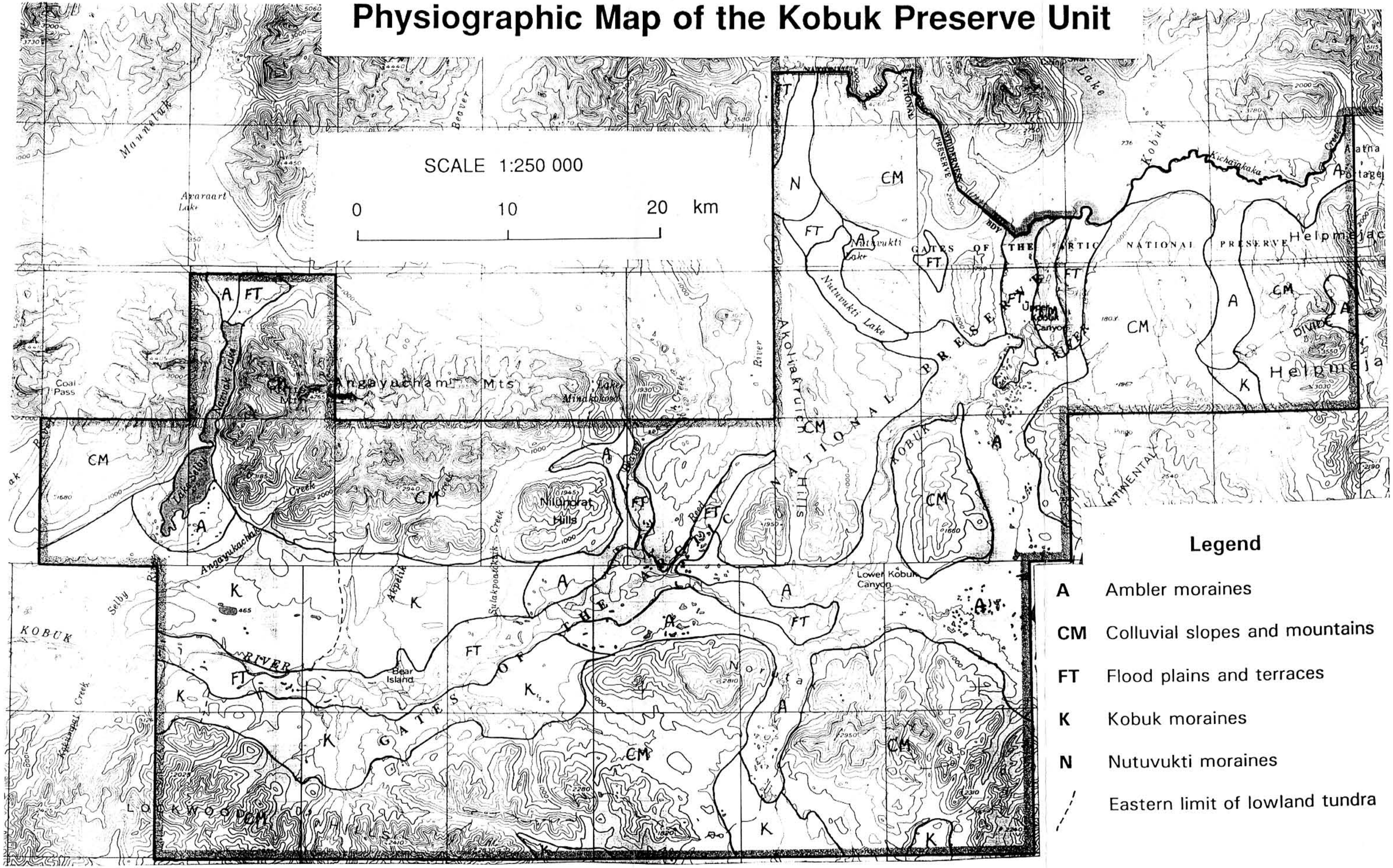
	PROPERTY	LIMITS			RESTRICTIVE FEATURE
		SLIGHT	MODERATE	SEVERE	
1.	USDA TEXTURE	—	—	ICE	PERMAFROST
2.	TOTAL SUBSIDENCE	—	—	>12	SUBSIDES
3.	FLOODING	NONE	—	RARE, OCCAS, FREQ	FLOODING
4.	PONDING	—	—	+	PONDING
5.	DEPTH TO HIGH WATER TABLE (FT)	>2.5	1.5-2.5	<1.5	WETNESS
6.	SHRINK-SWELL (THICKEST LAYER 10-40", PCT)	<3	3-6	>6	SHRINK-SWELL
7.	SLOPE (PCT)	<8	8-15	>15	SLOPE
8.	UNIFIED (THICKEST LAYER 10-40")	—	—	OL,OH, PT	LOW STRENGTH
9.	DEPTH TO HARD BEDROCK (IN)	>40	20-40	<20	DEPTH TO ROCK
9a.	DEPTH TO SOFT BEDROCK (IN)	>20	<20	–	DEPTH TO SOFT ROCK
10.	DEPTH TO CEMENTED PAN THICK (IN)	>40	20-40	<20	CEMENTED PAN
10a.	DEPTH TO CEMENTED PAN THIN (IN)	>20	<20	—	CEMENTED PAN
11.	WEIGHT PERCENT 3-10" (WEIGHT AV. 0-40")	<25	25-50	>50	TOO COBBLY
11a.	WEIGHT PERCENT >10" (WEIGHT AV. 0-40")	<5	5-15	>15	TOO STONY
12.	GYPSUM (PCT)	<5	5-15	>15	EXCESS GYPSUM
12a.	GYPSUM (PCT)			>40	SUBSIDES

TABLE 28: SOIL RATING CRITERIA FOR TOPSOIL

	PROPERTY	LIMITS			RESTRICTIVE FEATURE
		GOOD	FAIR	POOR	
1.	USDA TEXTURE	---	---	ICE	PERMAFROST
1a.	TEXTURE (THICKEST (LAYER 10-40")	---	LCOS, LS, LFS, LVFS	COS, S, FS, VFS	TOO SANDY
1b.	TEXTURE (THICKEST LAYER 0-40", >3% ORGANIC MATTER AND <35% CLAY)	SCL, CL, SICL	---		TOO CLAYEY
1c.	TEXTURE (THICKEST LAYER 0-40")	---	SCL, CL, SICL	SIC, C, SC	TOO CLAYEY
1d.	TEXTURE (THICKEST LAYER 0-40")	---	---	FB, HM, SP, MPT, MUCK, PEAT, CE	EXCESS HUMUS
2.	DEPTH TO BEDROCK (IN)	>40	20-40	<20	DEPTH TO ROCK
3.	DEPTH TO CEMENTED PAN (IN)	>40	20-40	<20	CEMENTED PAN
4.	DEPTH TO BULK DENSITY >1.8 G/CC (IN)	>40	20-40	<20	AREA RECLAIM
5.	STONINESS CLASS	1	2	3,4,5	TOO STONY
6.	WEIGHT PERCENT 2mm-3" (0-40") ZONE <3" DOMINATE FRACTION	<5	5-25	>25	TOO GRAVELLY
6a.	WEIGHT PERCENT 3-10" (0-40")	<5	5-25	>25	TOO COBBLY
6b.	WEIGHT PERCENT >10" (0-40")	<1	1-5	>5	TOO STONY
6c.	WEIGHT PERCENT 2mm-3" (40-72")	<25	25-50	>50	AREA RECLAIM
6d.	WEIGHT PERCENT 3-10" (40-72")	<15	15-30	>30	AREA RECLAIM
6e.	WEIGHT PERCENT >10" (40-72")	<5	5-15	>15	AREA RECLAIM
7.	SALINITY (THICKEST LAYER 0-40", MMHOS/CM)	<4	4-8	>8	EXCESS SALT
8.	LAYER THICKNESS (IN)	>40	20-40	<20	THIN LAYER
9.	DEPTH TO HIGH WATER TABLE	—	—	<1	WETNESS
10.	SODIUM ADSORPTION RATIO (0-40")	<4	4-13	>13	EXCESS SODIUM
11.	SOIL REACTION (pH, THICKEST LAYER 0-40")	---	—	<3.5	TOO ACID
12.	SLOPE (PCT)	<8	8-15	>15	SLOPE
13.	Ca CARBONATE (PCT, 0-40")	<15	15-40	>40	EXCESS LIME

Plates

Physiographic Map of the Kobuk Preserve Unit



Legend

- **A** Ambler moraines
- **CM** Colluvial slopes and mountains
- **FT** Flood plains and terraces
- **K** Kobuk moraines
- **N** Nutuvukti moraines
- Eastern limit of lowland tundra

PLATE 1. Physiographic map of the Kobuk Preserve Unit, Gates of the Arctic National Park

Recent Fire History of the Kobuk Preserve Unit

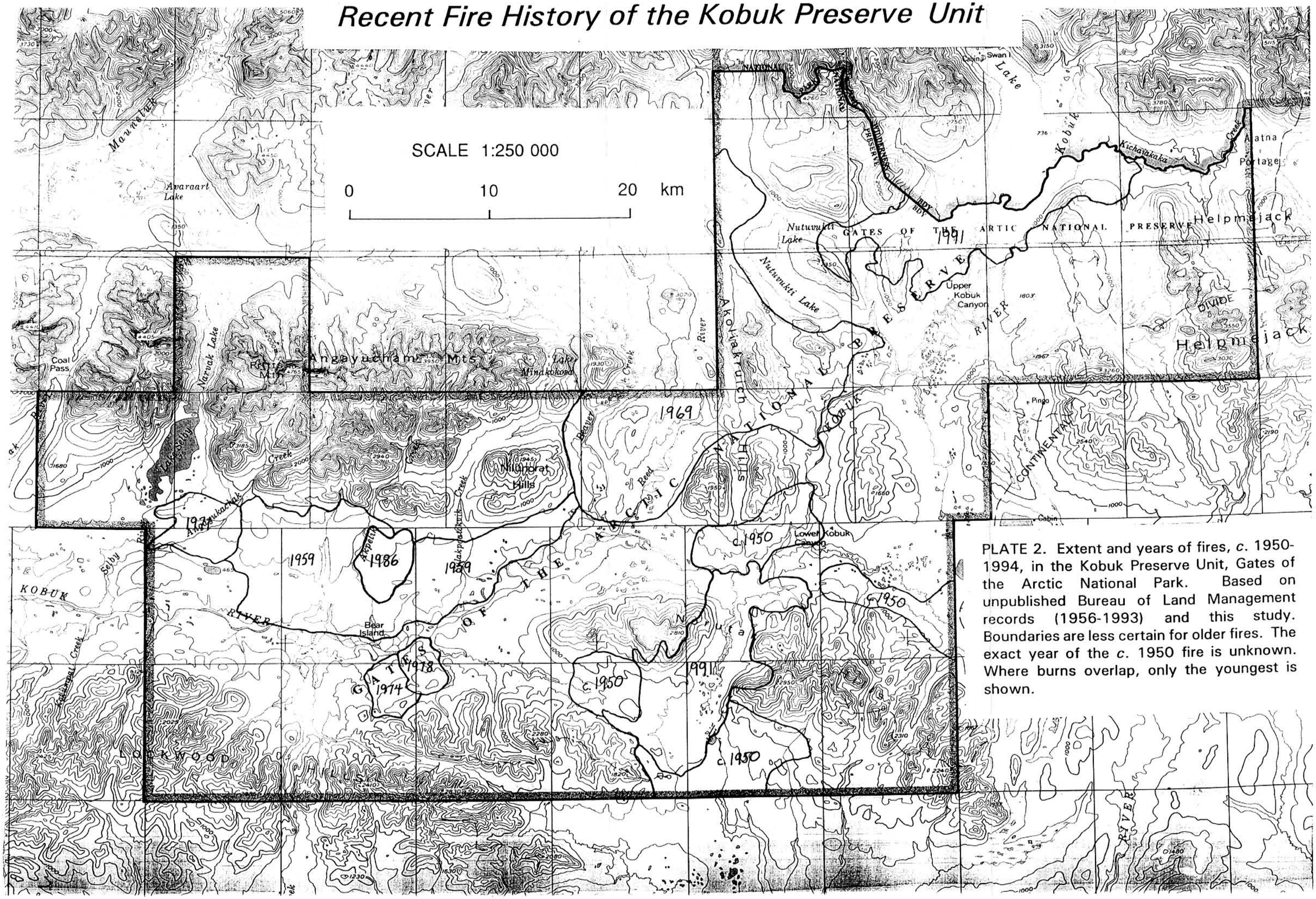


PLATE 2. Extent and years of fires, *c.* 1950-1994, in the Kobuk Preserve Unit, Gates of the Arctic National Park. Based on unpublished Bureau of Land Management records (1956-1993) and this study. Boundaries are less certain for older fires. The exact year of the *c.* 1950 fire is unknown. Where burns overlap, only the youngest is shown.

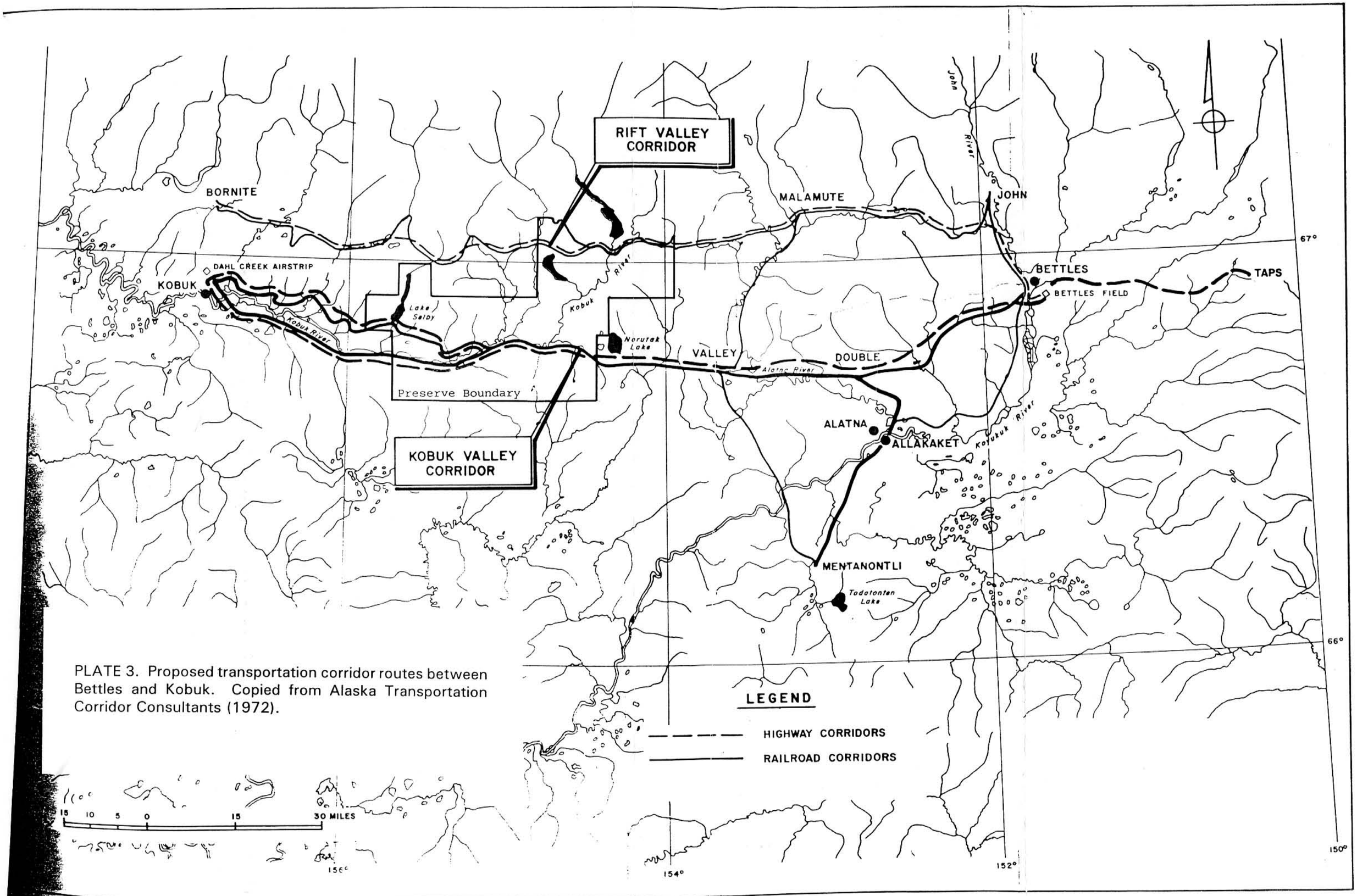
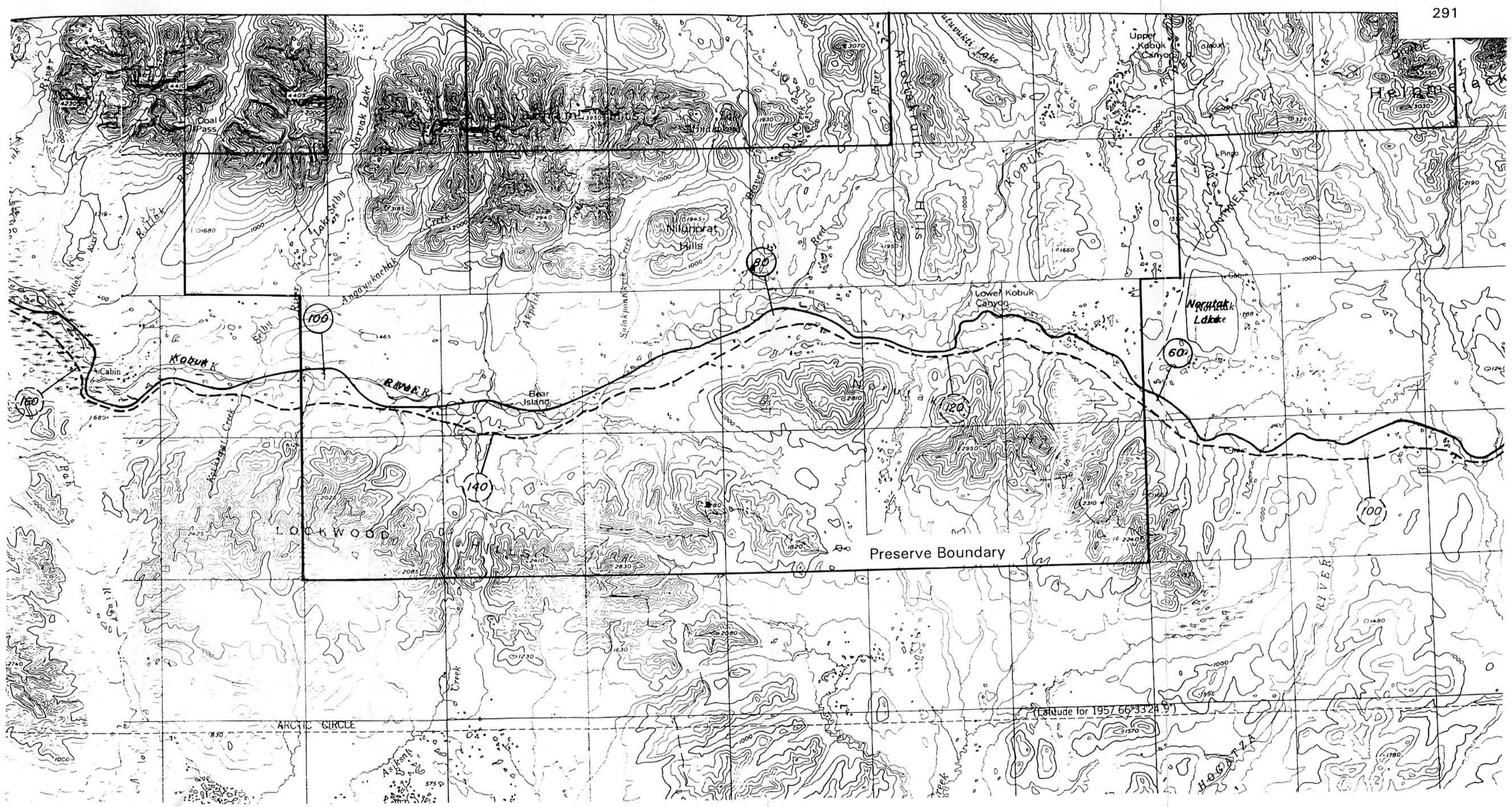


PLATE 3. Proposed transportation corridor routes between Bettles and Kobuk. Copied from Alaska Transportation Corridor Consultants (1972).



SCALE 1:250 000

0 10 20 km

PLATE 4. Detail of the proposed Kobuk Valley transportation corridor in the Kobuk Preserve Unit, Gates of the Arctic National Park. Copied from Alaska Transportation Corridor Consultants (1972). The proposed highway route is a dashed line, and the proposed railroad route is a solid line. The base map is the Hughes, Alaska US Geological Survey 1:250,000 quadrangle.

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January, 1995

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